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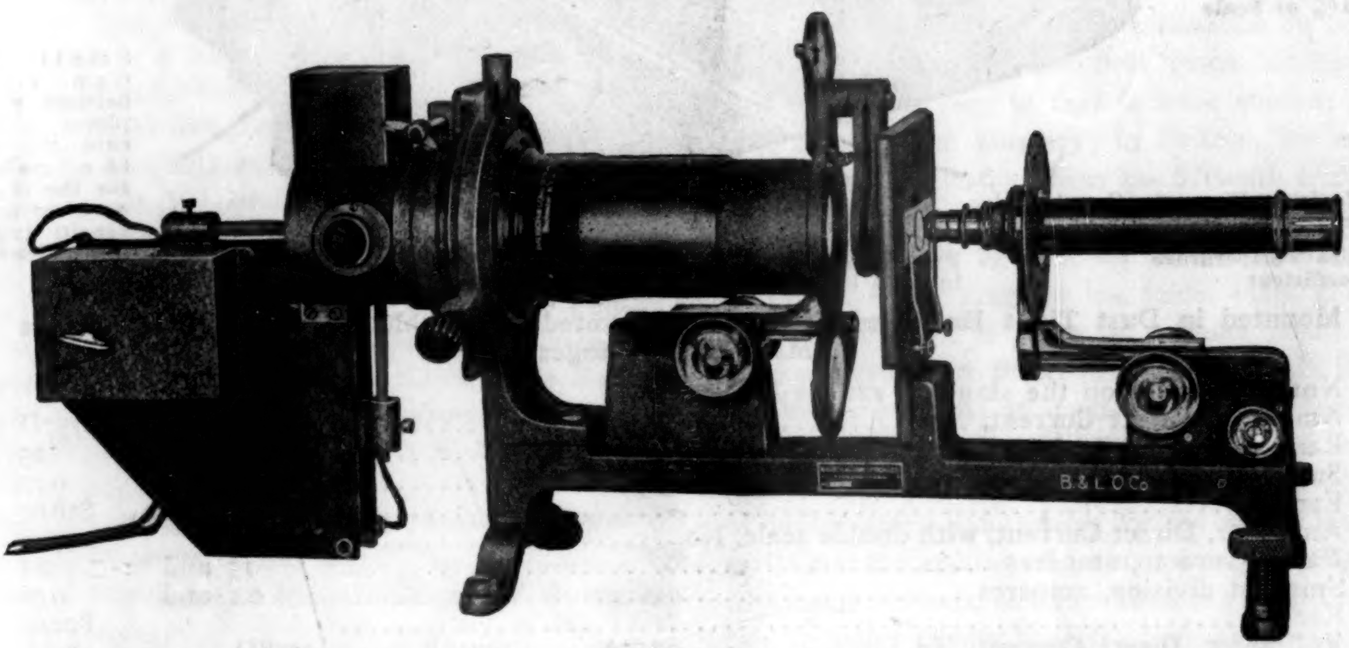

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AGRICULTURAL RESEARCH IN RELATION TO THE COMMUNITY[1]

It is a common reproach that agriculturists have not made the same use of science as have those engaged in the other great industries—that farming is still a rule of thumb process carried out by methods which have their origin in the dark backward and abyss of time. In some respects this is indeed true. One has only to read Cato or Columella to realize that the Italian peasant of to-day is working and living in very much the same way as his Roman forebears, and even the more highly organized farming of Great Britain or Denmark or Holland is carrying on many of the essential operations of cultivation on lines that were laid down by the first great civilizers—the Romans. It is easy in fact to trace modern agriculture to a Roman ancestry; in Britain, for example, by the transplantation from the fifteenth century onwards of the traditions and practices that persisted through the dark ages in the Low Countries.

None the less progress has taken place and scientific development is going on. Under medieval systems of agriculture the yield from England's land was of the order of six to eight bushels of wheat to the acre. The enclosure of common lands, the introduction of a recuperative clover crop into the rotation and of forage crops like turnips for the winter feeding of cattle and the making of farmyard manure, the return to Roman methods, in fact, raised the level of production to about twenty bushels of wheat per acre. This was about the average when agricultural science dawned nearly a hundred years ago—say about 1840, when Liebig exposed his theory of plant nutrition and Lawes began his experiments at Rothamsted. Growing scientific knowledge and the introduction of fertilizers raised the level of English production by 50 per cent. during the next generation, so that by 1870 the average yield of wheat per acre in England had become thirty-two bushels. At that level it has more or less remained down to the present day because a new factor then came into play, the importation of cheap wheat through the opening up of the middle west, of Argentina and of Australia. The economic factors of gold scarcity and rising costs of labor cooperated to limit the profit attached to high farming: the English farmer had to cheapen his production and lower his standard so that he only obtains the same yield to-day, though the acreage under wheat has shrunk on to the better land. Latterly we have seen

[1] An address delivered before the Graduate School of the U. S. Department of Agriculture, January 26, 1925.

the yield creeping up a little through the introduction of heavier cropping wheats—the products of scientific research.

In other directions there has been progress. The introduction of the self-binder alone has meant great economies in man power. From machinery in one way or another I estimate that English farming with an equal or greater output employs some 25 per cent. less labor than it did fifty years ago. Cattle feeding is more economic. Breeding for early maturity, better adjustment of rations either for meat or milk production, have all tended to a cheaper output. There is still an immense margin for improvement. From scientific experiments one may calculate with some degree of confidence how much meat and milk a given quantity of fodder of one kind or another ought to yield. Yet when in the dark days of the war we took stock of our resources in cattle food, because tonnage could no longer be spared for aught but human food, soldiers or munitions, it was estimated that in the five years before the war the farmers of the United Kingdom at large only realized one third of the meat and milk that was theoretically possible from the fodder that had been then available.

Disease amongst animals is another field in which research has not been idle; enormous savings have been effected in the average efficiency of our flocks and herds. Yet last year Great Britain had to pay a bill of approximately $20,000,000 to stamp out foot and mouth disease, and this was compensation only for slaughtered animals and took no account of the losses the farmers endured by the break-up of their businesses.

Great are the achievements and still greater the possibilities of agricultural research, but we must recognize that there are limitations to the effect of science upon agriculture which do not hold for the other industries. In the first place, in agriculture we are dealing with a living organism and the amount of control that we have obtained over plant or animal, over that stubborn essence we call life, is far less than we can exercise over inanimate nature, over iron or cement, over even the ether or the atom. When we attack vital problems we find that we can not speed up processes or enlarge the unit in the way we can deal with the dynamo or spinning frame. It still takes the wheat plant six or nine months to develop, and cows bring forth their calves neither more quickly nor more numerously for us than they did for Abraham. We see no way of growing three or four crops a year under temperate climatic conditions. The organisms we are dealing with will go through their cycle and you can not hurry them. When you start hustling you find you let in secondary troubles of all sorts.

These limitations lie in the nature of things, and though on looking back we can count up the immense advances that agriculture owes to the application of knowledge we must not hope for sudden developments or revolutionary changes such as have been seen in flying or wireless telegraphy. In fact for the time being I am bound to say that agriculture is actually suffering from the rapid developments and scientific achievements that have distinguished other industries. I say this advisedly and most solemnly. Agriculture is the fundamental industry, because we must all be fed, and yet you can not point to any part of the world where agricultural wealth is being turned out and find the producers in a flourishing condition.

The rewards in agriculture, whether to the capitalist entrepreneur or to the laboring man, are not commensurate with those obtainable in industry or commerce, and so men are being drawn away to the towns and capital is being diverted from the farms. The movement is one common to all civilized countries, its sources are social as well as economic. The lure of the town has been secular, but modern facilities of communication and transport have given it a range of action hitherto unknown; yet it can not go on forever, for the world must be fed. One must interpret the steady rise of food prices which has marked this century, a rise now being resumed after the excessive fluctuations caused by the war, as evidence that we are approaching a limitation to the development of the towns because there is not food enough to go round.

The old economists would see a simple solution to this impasse; prices of food have only to rise sufficiently and men will be attracted back to the land in order to secure the profits it promises—the balance will be restored. But, looking back historically, has this ever happened? I can find no example of an urban population migrating into the country. If the countryside does replenish itself in men it is by breeding and by finding space in the country for the country bred. The great increase in the food supplies of the world the last half century has witnessed has been due to the new countries becoming accessible, whereby opportunities were given to the rural population to put their sons on new land. But that process is nearly at an end, there are no longer the great vacant areas waiting for men.

Are we not to look for progress in another direction; can we not so intensify the farming of our existing land by taking advantage of science, machinery and organization that agriculture production will become an industry capable of competing against other industries for men and capital? It was by a process of this sort, by enclosing the common lands and building up small capitalist businesses, that Britain succeeded a century and a half ago in meeting the needs of a population which was then beginning to expand as the industrial age approached. Our businesses have remained small, too small to be efficient to-day

perhaps, and I can point to few examples of large scale industrial farming in successful operation.

In fact, though I pin my faith to big business on the land as necessary to the future production of food in order to meet the growth of cities, I am bound to say that the current seems sweeping in the other direction. Agricultural businesses, such as we have, find it difficult to pay the wages that will retain men on the land, with all its disadvantages of quietness and lack of amusement. Social and economic motives in our country are working towards the break-up of farming businesses into single man or rather family farms, and similar forces have been even more powerfully at work in Continental countries in dividing up the land. The desire of men for independence, the determination to call no man master, the innate feeling among country folk that a man has a right to a bit of land of his own as he has a right to a vote or to a soul of his own, makes in many countries the single-man holding a burning political question. And the man is ready to pay—to pay in labor, in days that endure from dawn to dark, in days that include the hours of his wife and children, in toil as against the regular pace of a factory, for the privilege of being a landowner.

But I doubt whether the process is fundamentally economic. Farming may become immediately more intensive when a great estate is cut up into small holdings, but the community so created becomes an unprogressive one, little fitted to take advantage of modern science, modern machinery, modern organization. It is fundamentally uneconomic because it is employing more men than are necessary to produce the food on which the community can be supported. I conceive it to be possible for 15 per cent. of the working population to be able to produce the necessary food for the rest of the nation, and the larger the margin that remains after this prime task has been performed of men who can be making boots and clothes, houses and motor cars, the greater the divisible wealth of the community.

But the only hope I can see at present for large-scale production, for organized industry on the land, lies in the advances that science can make. It is research alone that will enable the big agricultural business to compete with the excessive labor of the one-man farm, to pay wages and give conditions of life to its workmen equal to those prevailing in the urban industries. It becomes then a matter of the first import to the growth of civilization itself, not merely to agriculture, that agricultural research should be encouraged.

We may consider research from two points of view. In the first place, it is an intellectual affair carried out by the individual in response to the insatiable curiosity of the mind about its surroundings and its own existence. As such, it proceeds from an artistic impulse, it is not under control and it is not amenable to considerations of utility. Just as some men must write poems or paint or make music, as other men find themselves compelled to speculate, to become philosophers or metaphysicians, so similarly the class of men we are considering must investigate nature.

The passion to do this is part of the man's make-up and can not be created by any act of will on his part. I may remind you of the story of the old school-fellow who met Dr. Johnson at the height of his fame. "Doctor," he said, "I have often tried to become a philosopher myself, but cheerfulness will keep breaking in." And as a man can not deny himself a desire to investigate, so he is not drawn to investigation by any ulterior motive.

I may take an illustration in the science of astronomy. Historically the study of the stars would appear to have had its beginnings in the search for useful knowledge. In the early civilization of Egypt it was necessary to find out a means of determining exactly the length of the year and the recurrence of the seasons. Later on the delusive promises of astrology led to further observation, and as we know, the first organized observatories were built for the service of the sailor for the drawing up of what we call a nautical almanac. But these prime necessities were easily satisfied and the real science of astronomy can not for the last hundred years have served any useful purpose to any man. Nonetheless, the development of the science and the foundation of observatories has proceeded at a greater pace than ever before, purely in response to the universal feeling of curiosity. Oddly enough, this kind of knowledge has proved itself singularly attractive to the American millionaire, who has latterly been the great founder of observatories. Indeed the uselessness of astronomy is to many people one of its great attractions. A great astronomer once said to me, "One advantage I enjoy is that my science can not make money for anybody —at least no merchant traffics in my heart." We may parallel this feeling with the remark of some noble lord who was being congratulated on his elevation to the Garter, "The best of the Garter is that it implies no damned nonsense about merit."

Research again possesses this quality in common with what are usually called the arts—its characteristic mental process is intuition. When we were students we used to be told that the two processes of thought by which science proceeded were deduction and induction. It was pointed out that the barrenness of the medieval schoolmen was due to the fact that they worked by deduction alone from imperfect premises. Bacon became the father of modern science by recalling it to induction and to the painful collection of facts. Bacon's apothegm was recalled,

"Hypothesis non fingo," and it was suggested that the method of science was to collect an assemblage of facts and put them into some kind of sorting machine, whereupon a theory will emerge. However, a little examination of the actual history of discovery soon shows that it does not proceed in such a fashion. The function of facts is to provide tests for your hypotheses, but you can not begin to collect the facts unless you have a preliminary hypothesis.

Let me take an example in the science of meteorology. For generations people made observations of the weather, set down the records of temperature, rainfall, barometric height and so forth. Nothing whatever came of these facts until in the study one or two workers evolved from their own consciousness the theory of the cyclone. Induction in fact failed. Bacon's other great catchword, "Experimentum crucis," showed that he really had a better appreciation of the true processes of science, and the really beneficial influence he exerted upon the early science of the seventeenth century was that he directed men's attention to experiment and to the mechanic arts as the sources of knowledge. To come back to our text, neither induction nor deduction complete the story of the mental processes by which investigation proceeds. We now realize a third category in the shape of intuition, the power of seizing the truth by a sudden flash of illumination. Indeed the great discoverer may be a man in whom what is commonly called the scientific habit of mind is imperfectly developed. He may not be severely logical, methodical in his arrangement of facts, meticulous in accepting deductions.

As a recent example we may instance the late Sir William Crookes, whose marvelous discoveries certainly did not proceed by a process of minute but steady accretions from known foundations. By a sudden jump of mind he invented the radiometer, regarding which his explanations were mistaken, but his intuition led him from this point on to the whole gamut of high vacuum discovery which has resulted in such developments as the Röntgen rays, the elucidation of the structure of the atom, wireless telephony, etc. Sir William Ramsay provides another instance. In the eighteenth century Cavendish had noted that after removing all the oxygen and nitrogen from air a small residuum was left uncombined. In true scientific spirit he put this down to the inevitable errors of the experiment. But working on the same track and worrying over the discrepancy between the atomic weights of nitrogen obtained from different sources, Ramsay's intuition led him on to the discovery of argon and the range of new light elements.

So far I have only been considering research from its intellectual side as a response to man's curiosity, but the nineteenth century proved it had also a practical side inasmuch as it led to an enormously increased control over the forces of nature. I need not sing the praises of what has been effected by steam, by electricity, by modern medicine; willynilly the results are being incorporated into our daily life. Research leads to efficiency, and efficiency is a means of making money. The modern state must cultivate research if it is to become efficient and survive in the world's competition; hence all are agreed now on the endowment of research, and since in farming there are no great business corporations agricultural research must for many years to come be maintained by the state.

If, then, research is to become of such importance to the state, it behooves us to ensure conditions for the research worker under which discoveries are likely to be produced. To do this properly we must understand the psychology of the investigator. If it is true that research, like art, grows by a process of intuition, we can no more organize it into existence than we can organize the output of poetry. Nor are we likely to obtain it by a system of prizes, of rewards, commensurate to those obtained in the great professions, in industry or commerce. What we can do is to contrive sheltered places in our community in which research workers can live. We can not guarantee results, but we may wait in faith because, as we have said, the impulse to make discoveries is fundamental in man's mind. Now the sheltered places in which the research worker can live are the universities.

One last word, the state must have research in order to obtain efficiency, but does mankind really care about efficiency? At bottom man does not, he wants to "loaf and possess his soul." Efficiency is a beautiful word, but efficiency to what end? If pursued for its own sake it may become a curse. Many people have vivid recollections of the sufferings they endured under a really efficient parent in an efficient household. I, myself, am officially engaged in promoting efficiency, in bringing up the efficient farmer and in insuring the efficient use of the land. But I can not help having a great deal of sympathy with the old-fashioned farmer, who is content with what the land brings him, who is making his living but not worrying overmuch about making money. He is often inefficient, but again he is often a very worthy human being.

To take another illustration, I have a vivid recollection years ago of a little piece of swampy meadow, half encircled by a brook, which after other wanderings found its way into the Thames. There was a patch of reeds and willows, an old salley garden, where the reed warbler swung her nest and flitted through the tangled herbage. The wet meadow itself was starred over in August with Grass of Parnassus. In it was indeed one of the most southern holds of that flower of the cool northern hillsides. Well, the efficient man came along, saw his opportunity,

grubbed up the willows and laid out the meadow in watercress beds. He is a benefactor of his kind and has caused millions of blades of an edible kind to grow where there was none before; but I have a sore spot in my heart for the vanished warblers and the lost Grass of Parnassus. I fear, however, that the pursuit of efficiency is one of those contradictory elements in man's make-up that won't let him rest, that is always urging him against his will towards further attainment. What a dreary prospect if it only results in adding an ever greater and greater population to a world always working harder and harder! Is there any way out of this impasse? I can only again suggest the kindly force of that other element in the texture of men's minds, the passion for artistic expression. The winds of beauty come and go, but as they rustle through the tree of life, among the dropping leaves that are ourselves, men will cease from their toil to listen and pause while they tell of them in their own speech.

A. D. HALL

SOME SUGGESTIONS ON CLASSIFICATION

IN a note to SCIENCE,[1] the writer called attention to the very antiquated system of classification still in vogue among many botanists, and ventured to suggest that it might be worth while to adopt a system more in harmony with our present knowledge of the relationships of the larger division of the plant kingdom.

That a definitive classification is not possible at present the writer fully realizes; and the present communication is offered rather as a suggestion for further consideration of the subject than as a definite scheme to be adopted *in toto*.

Surveying the whole plant kingdom, we find below the mosses an immense heterogeneous assemblage of plants, which even now it has pleased most of our text-book writers to treat as a single primary division, or sub-kingdom, Thallophyta.

This, it seems to the writer, is no more justified than it would be for zoologists to consider all invertebrates as belonging to a single sub-kingdom. It might be permissible to retain the term Thallophyte as contrasted with the Embryophytes (Archegoniates and Spermatophytes), but only as the zoologist may find it convenient to discuss invertebrates in contrast with vertebrates, without any thought that the two are in any scientific sense coordinate.

Just as the invertebrates are universally recognized as comprising a number of quite distinct sub-kingdoms, so the "Thallophytes" include several groups, each of which should be treated as a primary division or sub-kingdom, coordinate with the whole group of Embryophytes.

When it comes to delimiting these sub-kingdoms, however, there may well be a difference of opinion as to how many of them should be recognized.

At the bottom of the scale are the extremely simple and presumably ancient forms like Bacteria, Cyanophyceae, Flagellata and Slime-moulds or Myxomycetes. The two latter have obvious relationships with the lower Protozoa, and we might perhaps adopt Haeckel's term Protista to include them; or, perhaps, we might unite these lowest plant-forms into a single sub-kingdom Protophyta.[2]

Above these simplest organisms are two great assemblages of plants, Algae and Fungi, as to whose origin and inter-relationships we have still much to learn.

The division of the higher plants or Embryophytes into Archegoniates and Spermatophytes is a more or less artificial one, and as they are all undoubtedly more or less intimately related, we shall probably best reduce them to a single sub-kingdom, Embryophyta.

The classification adopted by most of our text-book writers is essentially that of Eichler,[3] published in 1883, and even then decidedly antiquated.

The writer[4] in 1890 ventured to discard the term Thallophyte, and recognized the Algae and Fungi as primary divisions or sub-kingdoms. The term Protophyte was adopted from Sachs's Text-book, to include the Schizophyta, Myxomycetes and Volvocineae.

Engler in "Die Natürlichen Pflanzenfamilien"[5] divides the plant kingdom into Thallophytes and Embryophytes, the latter including the Archegoniates and seed-plants. The Thallophytes were divided into Myxothallophyta (= Myxomycetes) and Euthallophyta including Schizophyta, Algae (Euphyceae) and Fungi (Eumycetes).

In 1907 the late Professor C. E. Bessey published his "Synopsis of Plant Phyla,"[6] in which he discards the term Thallophyte and recognizes fifteen "phyla," or primary divisions. In this classification he does not include either the Myxomycetes or Flagellata. He divides the Green Algae into three phyla, exclusive of the Characeae, which he unites with the Red Algae, "Carpophyceae." The Phycomycetes are as-

[1] SCIENCE: Vol. LX, No. 1542, 64–65, July, 1924.

[2] See Sachs, Text-book, English translation, 1882, p. 244.

[3] Eichler, A. W., Syllabus, 3rd Edition.

[4] Campbell, D. H., "Elements of Structural and Systematic Botany."

[5] 1897.

[6] University Studies, Vol. VII, No. 4, University of Nebraska, Oct., 1907.

sociated with Green Algae, and the Diatoms are made a class, "Bacillarioideae," of the "Zygophyceae." Four phyla of seed-plants are recognized, "Cycadophyta," Gnetales, "Strobilophyta" (Coniferae) and "Anthophyta" (Angiosperms).

Engler, two years later, published his Syllabus,[7] in which he follows Bessey's arrangement to a considerable extent, also omitting entirely the term Thallophyte. He recognizes thirteen primary divisions, *viz.*, Schizophyta, Myxomycetes, Flagellatae, Dinoflagellatae, Bacillariales, Conjugatae, Chlorophyceae, Charales, Phaeophyceae, Rhodophyceae, Eumycetes, Embryophyta-asiphonogama (Archegoniatae), Embryophyta-siphonogama (Spermatophyta).

That the authors of some of the recent text-books should prefer the obsolete classification of Eichler to the much more scientific system of Engler seems rather extraordinary.

While agreeing in the main with Engler's classification, the writer would be inclined to unite some of Engler's primary divisions. It may be questioned whether the Dinoflagellata (Peridineae), Diatoms, Conjugatae and possibly Characeae, are sufficiently distinct to warrant raising them to the rank of sub-kingdoms. The writer believes that the Conjugatae, and probably the Characeae, should be included in the Chlorophyceae, while the Peridineae might either be included with the Flagellata, or possibly be regarded as the lowest of the Phaeophyceae. It is even possible that the Diatoms might also be united with the latter.

Should these suggestions be accepted, we should then reduce Engler's primary divisions to nine.

It is pretty generally admitted that the origin of the Chlorophyceae and Phaeophyceae is to be sought among the Flagellata; but the two classes have probably arisen quite independently from green and brown flagellates, respectively.

The writer believes that the Green Algae, with the possible exception of the Characeae, form a homogeneous class, and can be traced back more or less directly to some flagellate forms not unlike Chlamydomonas. The succession of forms from the flagellate unicellular stage to the highly organized forms characteristic of most Phaeophyceae is not nearly so evident as in the Green Algae; but some of the simplest of the Peridineae closely resemble the zoospores of the Phaeophyceae and may possibly be remotely related to them.

The systematic rank of the Peridineae and Diatoms is difficult to determine; but some of the investigations on the development of the simpler Diatoms point to a possible derivation from forms related to the Peridineae, and as some of the simplest types of the latter much resemble the brown zoospores with lateral cilia, characteristic of the Phaeophyceae, it might possibly be justifiable to include the Peridineae and Diatoms with the Phaeophyceae, as the simplest members of the class. The origin of the Red Algae is more obscure and they may possibly be an offshoot of the Chlorophyceae.

In view of the decidedly doubtful origin of the Phaeophyceae and Rhodophyceae, it may be well, for the present, to unite all the Algae in a single sub-kingdom, the three main divisions being treated as classes; and perhaps the Peridineae and Diatoms might also be ranked as classes.

The relationships of the Fungi are even more obscure than those of the Algae. This immense assemblage of parasites and saprophytes have become so much changed from the normal plant-type that in most cases a comparison with the Algae is almost impossible. Whether the Fungi form a single homogeneous group, or whether they include several unrelated phyla, it is now impossible to say; and for the present, at least, we shall probably best keep them together as a single sub-kingdom.

Engler, as already mentioned, proposed the very appropriate term Embryophyta for the higher plants, *viz.*, Archegoniates and seed-plants, which he calls, respectively, E. asiphonogama and E. siphonogama, based upon the absence or presence of a pollen-tube.

The old separation of the Archegoniates into two sub-kingdoms, each coordinate with the whole assemblage of Thallophytes, is still maintained in many of the standard text-books, although the absurdity of such a divorce of the two obviously related divisions of the Archegoniates is apparent to any one with a first-hand knowledge of the close resemblances in the essential structures of both gametophyte and sporophyte in the less specialized members of the Bryophytes and Pteridophytes.

Adopting the changes suggested by the writer for Engler's system, there would remain nine sub-kingdoms, *viz.*, Myxomycetes, Schizophyta, Flagellata, Chlorophyceae, Phaeophyceae, Rhodophyceae, Fungi (Eumycetes), Embryophyta asiphonogama (Archegoniatae), E. siphonogama (Spermatophyta).

We might still further reduce the number of primary divisions by uniting the three first into a sub-kingdom Protophyta, and combining all the Algae into a single sub-kingdom. It would be logical, also, to unite all the Embryophytes into one sub-kingdom.

The following scheme is offered as a suggestion based upon the above proposal:

Sub-Kingdom I, Protophyta	Class 1, Myxomycetes Class 2, Flagellata Class 3, Schizophyta

[7] Engler, A., "Syllabus der Pflanzenfamilien," Berlin, 1909.

Sub-Kingdom II, Algae		Class 1, Peridineae (Dinoflagellata) Class 2, Bacillarieae (Diatoms) Class 3, Chlorophyceae Class 4, Phaeophyceae Class 5, Rhodophyceae
Sub-Kingdom III, Fungi		Class 1, Phycomycetes Class 2, Ascomycetes Class 3, Basidiomycetes Class 4, Lichenes
Sub-Kingdom IV, Embryophyta	A. Bryophyta	Class 1, Hepaticae Class 2, Anthocerotes Class 3, Musci
	B. Pteridophyta	Class 1, Filicineae Class 2, Equisetineae Class 3, Lycopodineae Class 4, Psilotineae
	C. Spermatophyta	Class 1, Cycadophyta Class 2, Coniferae Class 3, Gnetales Class 4, Anthophyta (Angiosperms)

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GUADALUPE ISLAND: AN OBJECT LESSON IN MAN-CAUSED DEVASTATION

IN these days when conservation of natural resources is happily coming to occupy an important place in the nation's thought and plans, it may be of value to consider a most striking example of the utter ruination which man, within comparatively few years, is capable of effecting in nature's long-developed scheme. I refer to Guadalupe Island, a volcanic peak which rises out of the ocean some 150 miles west of Lower California and which I have twice visited during the past two years in the interests of the Natural History Museum of San Diego.

In contrast with most of the other islands on the west coast of the peninsula, which are completely arid, Guadalupe's crest is lofty enough to tap the clouds, and as a result its summit was blessed in bygone days with forests of cypress, oak, pine and palm, as well as with many other smaller shrubs and flowers. This flora became a natural refuge for many birds, although Guadalupe was too far from the mainland to be entered by any land mammals. Through the ages, many of the plants and birds, by their long isolation, became differentiated from mainland forms, and this gave the island a unique natural history interest.

The first event to shock the tranquility of the place, so far as our knowledge goes, was the discovery by sealers, about the end of the eighteenth century, of several rookeries of fur seals (*Arctocephalus townsendi*) on the rocky shores of Guadalupe. In the ensuing years, Russians, British and Americans seem all to have had a hand in the slaughter of the seals, which was continued relentlessly till about 1830. It is believed that many of the skins were used in the Oriental trade, which was flourishing at that time. During this period stone houses were erected for the seal-hunters, the walls of which still remain. It was probably as a result of these first human invasions that the common house mouse was introduced on Guadalupe and, with it, the domestic cat. These two animals, so foreign to the natural fauna of the island, were destined later on to play a lamentable part in the overturning of nature's balance. When the fur seal rookeries became so depleted as to offer their exploiters no further profit, the sealers left the island, although they had not completed the extermination of the animals.

The next, and by far the most serious intruders upon Guadalupe were the whalers, although, during their brief visits, they did not stop much longer than was necessary to fill their water casks. However, to the whalers is attributed the grave responsibility of having liberated goats upon the island. It is supposed that their idea was to have a convenient place where fresh meat might be obtained on later cruises. No doubt their plan was logical, so far as it concerned themselves, and for a time their demands may have prevented undue increase of the goats. But, with the advent of more settled routes of transportation and boats with better facilities, the goats that had been released on Guadalupe were forgotten and left to their own resources. The place proved to be a goats' paradise, for with plenty of low herbage and not a single enemy, they had life their own sweet way. They increased by tens of hundreds, devouring everything green that was in sight and gnawing their way into the very heart of the primeval forest.

Meanwhile, the northern elephant seal (*Mirounga angustirostris*), another native resident of Guadalupe and its adjacent waters, began to be sought after and persecuted. Whales were becoming scarce and their hunting grounds more distant. Therefore, when the great blubbery elephant seal could be found sunning himself on the sandy beaches, he fell a ready prey to the whaler and his try-pot. At this time, gold had been discovered in California and the demand for whale oil was tremendous, for it filled the place of kerosene in those early days. Man, in his greed, turned to the easiest thing obtainable and the elephant

seals were reduced to the verge of extinction. In fact, for many years leading authorities thought that they had been exterminated. Nevertheless, in 1892, a party of scientists led by Dr. C. W. Townsend was gratified to find that a small group of elephant seals still existed on Guadalupe Island.

In the case of the fur seal, too, nature had done her best to recuperate. In the early eighties, word was passed about that a few fur seals could still be found on the island. Free lance seal-hunters at once set out from the coast of California and relentlessly pursued the unfortunate seals, invading even the caves to which the last of the herds had retreated. Even though certain of these caves were accessible only during the lowest tides, the protection thus afforded did not save the remnant of the fur seals from complete extermination. Had a few been left to survive, it is possible that the seals might have regained their strength and might to-day be netting Mexico a handsome sum annually, through the sale of their pelts, just as the fur seals of the Pribilof Islands yield to the United States a revenue of about a million dollars a year.

In spite of the damage to Guadalupe Island's bird and plant life that must already have been wrought by mice, cats and goats, Dr. Edward Palmer, well-known government botanist, who visited it in 1875, described it as a "naturalists' paradise." It would seem, however, that he arrived only in the nick of time to secure a few of the vanishing birds and plants and thus preserve their memory forever in the annals of science. After his departure, some of the birds were never again seen by ornithologists. If Guadalupe was a naturalists' paradise in 1875, what must it have been in its unspoiled glory!

Following the history of this luckless island till modern times, we find that, for a short time in the end of the nineteenth century, it was used as a penal colony by the Mexican government. However, the effect on natural conditions of its habitation for this purpose was probably negligible, since the island had already given nearly all it had, directly or indirectly, to human greed.

In the first part of the twentieth century, man again turned his eyes toward Guadalupe, this time with his attention on her unnatural possession—the hordes of goats. Corrals were built about the water hole on the summit of the island and vast numbers of the goats were butchered for their pelts and tallow. But they had increased to such an extent that the inroads of several of these expeditions had no appreciable effect upon their abundance. During the World War the goats were again exploited, being taken to San Pedro and San Diego, where they were kept for fattening. However, the many years of over-population had had its effect upon the size of the goats and the quality of their flesh, and the project was a failure owing to the high cost of transportation and feed.

My own acquaintance with Guadalupe Island dates only from 1923, when the overwhelming goat population, by devouring every green thing within reach, had for many years prevented the natural increase of any form of plant life. The condition of the island at this time has well been described as that of a "biological sepulcher." There was, however, one tremendously encouraging feature of my first visit, which was made at the invitation of the Mexican government, for no less than 366 elephant seals were counted as they lay basking on the ancestral beach—by far the largest number that had ever been recorded. The following year (1924) I was again invited to make a census of the elephant seals and found only 124 animals. Reduction of the number does not, however, necessarily indicate a corresponding diminution of the herd, as there was a difference of six weeks in the time of year when the count was made—July 16 in 1923, and August 30 in 1924—and our knowledge of the movements and life history of the elephant seal is still too meager to warrant the drawing of definite conclusions.

On the other hand, a keen look-out during both years for a single possible remaining fur seal proved fruitless. In 1923 complete circumnavigation of the island failed to reveal the slightest trace of these animals, although the polished rocks of the rookeries and even the tiny wooden pegs used a hundred years ago by the seal-hunters to stretch out the skins to dry, could still be found in place on the old killing grounds. It is known that in the more recent raids upon the fur seals their pelts were preserved by salting and not by drying.

What, then, from a naturalist's standpoint, does this former "paradise" hold in the way of hope for the future? Surely nothing of its former wealth of plant and bird life. These are gone forever. From now on the fame of Guadalupe must lie in the fact that it harbors the only known herd of northern elephant seals on earth. Even for them a new and modern type of persecution has lately arisen in the form of disturbance by curious or mercenary photographers and "movie" men. To the lasting credit of Mexico let it be said that she is fully awake to the unique interest of her "elefantes marinos" and has now created Guadalupe Island a federal reservation, protected by a permanent garrison of soldiers. As a result of this wise action, it is within the realm of possibility that these strange animals will have oppor-

tunity to increase until they once more inhabit their ancient haunts up and down the coasts of the two Californias.

LAURENCE M. HUEY
NATURAL HISTORY MUSEUM,
SAN DIEGO, CALIFORNIA

ROGER FREDERIC BRUNEL[1]

IT has been my good fortune to come in close contact with the scientific work of Dr. Brunel from a number of points of view, and I consider it a privilege to have the opportunity to endeavor to make clear in a non-technical way the value and significance of his contributions to the science of chemistry.

My interest in Brunel's work was aroused by his first publication because I was working in the same general field of chemistry and because of the fact that we were graduates of the same university. The thesis presented by him in connection with his work for the doctorate gave a clear indication of his skill in experimentation, and an insight into the kind of a problem that aroused his interest. In contrast to many researches in organic chemistry which have as their aim the preparation of a series of new compounds lacking theoretical interest, the problem under study had to do with the more fundamental properties of molecules. Chemistry is concerned primarily with the study of the transformation of one kind of molecules into another kind. Only recently has attention been paid to what may be called the mechanism of such transformations—that is, the manner in which reaction takes place between the chemical units. Research of this kind involves the development of new methods and a high order of scientific imagination. It is more difficult and less likely to yield a wealth of new facts suitable for publication. It requires quantitative measurement and the point of view of the physicist.

The fact that Brunel began his research work in this special field of organic chemistry, no doubt, was the determining factor in his subsequent activities. All his published work has to do with the study of the most fundamental things of the science. The reputations of many chemists are based upon the fact that they have added perhaps hundreds of new substances to the long list of known organic compounds—Brunel was attracted by the more profoundly important problems of how molecules interact and the nature of chemical affinity itself.

His association with Professor Arthur Michael, immediately upon graduation, was most fortunate, because he came in the closest contact with the leading investigator in organic chemistry in America, and a man of international reputation on account of his leadership in what I may call the philosophy of the science. Michael was studying chemical affinity from the standpoint of energy, and the work of the two investigators led to results of great value.

When I was asked to review Brunel's work I wrote to Professor Michael to tell him of the action taken by the authorities of Bryn Mawr, as I knew he would be pleased at this recognition of the services of his former co-worker. I have just received a reply to my letter from Professor Michael from Bermuda. He writes:

> The sudden death of Dr. Brunel was a shock to me, as it must have been to his other friends, who, like myself, know his fine personal character. He worked two years with me, so I had ample opportunity to appreciate his acute, rare mentality, and his unusual skill in experimentation. I have always considered Dr. Brunel one of our ablest investigators in organic chemistry, who already had made notable contributions to the science and of whom much might have been expected.

The work done with Michael had for its object the study of variations in chemical affinity brought about as the result of the change in the arrangement of the atoms in molecules of the same composition. In these researches the quantitative point of view, which is not considered in so much work in organic chemistry, was stressed as before—the results obtained were of great scientific value. It may be interesting to point out here that these results have been found useful in connection with certain industrial developments based upon the compounds studied.

One of the outstanding contributions of Brunel was the paper published in collaboration with Marguerite Willcox. This investigation centered around the study of the relative chemical affinities of certain important groups of atoms. The concept of chemical affinity was that derived from modern physics and physical chemistry, and quantitative measurements were made. The mode of attack of the problem and the detailed plan were both most ingenious. The research is a model that could well be followed in investigating further chemical affinity, and this study is, to my mind, the most important problem before chemists to-day.

Another paper published by Brunel, in collaboration with Crenshaw and Elsie Tobin, illustrates a second type of research in which he was a master. In this paper are recorded the properties of certain alcohols. The materials upon which measurements were made with a high degree of accuracy were first obtained in an unusually pure condition. The work showed great attention to details, and the results are taken as standards by organic chemists.

A short time ago one of my own students was preparing a sample of an alcohol and I questioned him as to the purity of his product. He replied with a

[1] Address at the meeting in memory of Dr. Brunel held at Bryn Mawr College on February 5, 1925.

sense of conviction as to the success of his work, that the properties of his material were identical with those published by Brunel. He was satisfied and so was I.

During the war Brunel interrupted his work to take up certain investigations on war gases suggested by the authorities in Washington. He studied with his customary care certain gases which were used to induce a copious flow of tears. Such gases served an important purpose in interfering with the preparations which are necessary before an attack is made. Lines of communication are shelled and, as a result, all work must be done by soldiers who are protected by masks. These cut down markedly efficiency and, consequently, slow up military operations. I had the pleasure of communicating to English chemists, who were working on the same substances, the results obtained by Brunel. As a result their efforts were turned to other problems.

James F. Norris

SCIENTIFIC EVENTS

WORLD WHEAT PRODUCTION[1]

During the past ten years it has been realized that all the countries in the world have a common bond in the international trade in wheat. Various adjustments in relationships have perforce been necessary, but the six years which have elapsed since the war have given wheat-growing countries time to stabilize their positions and in some degree to accommodate themselves, on one hand, to the cessation of export from Russia, and, on the other hand, to the discontinuance of the artificially enhanced production prevalent during the war years. For this reason the agricultural statistics for 1923 published by the International Institute of Agriculture at Rome, with their comparisons with pre-war years, are of special interest, since they do at this stage indicate the trend which agriculture in general and wheat production in particular is taking throughout the world.

The situation as revealed by the year-book is, on the whole, reassuring. Except in Europe, both area and production in wheat show an increase over the corresponding figures for the period 1909–1913. In North America the increases in area and production are approximately 40 per cent. The year 1923 was admittedly a favorable one for wheat growing, but an examination of the annual returns shows that this increase is not an isolated instance. Europe is still 7.3 per cent. below its pre-war average in production of wheat, and 9.5 per cent. below its average area in that crop over the same period; but the area has increased steadily since 1920, and the production, notwithstanding fluctuations, has never fallen lower than it was then.

Russia is omitted from these returns, but the decrease in wheat production in that country during 1922, when famine conditions were at their worst, is now authoritatively stated as fifty-five and a half million quarters, or 65 per cent. of the pre-war average. In 1923 Russia had a small export trade. It will be remembered that, before the war, Russia was one of the chief sources of the world's wheat supply.

A good deal of attention has recently been directed towards the wheat production and crop balance-sheets of Canada and the United States. No appreciable decrease in area under cultivation in either country is recorded in the data published, but wheat production in both is less in 1923 than in 1922. Almost the whole of this loss can be apportioned to the United States, where increases in the more important crops of cotton and maize more than counterbalance it. Four million acres went out of wheat in 1923 and 5.4 million were added to the maize and cotton crops. Further, the excess of exports over imports of wheat has fallen from 32 million quarters in 1921 to 9.6 millions in 1923. Taken together, these figures would seem to afford a striking confirmation of the forecast made by the Bureau of Agricultural Economics in the U. S. Department of Agriculture Year-book for 1921. In a paper on "Wheat Production and Marketing," O. E. Baker says, "Wheat production, however, has been increasing less rapidly than population in this country, and it is very probable that this will continue to be true, at least until we reach the point where we consume practically all we produce." Such a state of affairs is obviously of very serious import.

The International Year-book has grown during its brief career, and this issue gives many more details than its predecessors. It is to be regretted that in so doing it has been thought necessary to discontinue some of the summary tables. That relating to the percentage of each crop, based on total area under cultivation in each country, is a noticeable omission. The book contains sections dealing with crops, live stock, trade returns, prices, freight charges, fertilizer consumption and rates of exchange, and will repay perusal not only by the agriculturist and economist but also by the interested layman.

THE TRANSMUTATION OF MERCURY

The department of chemistry of the University of Chicago has authorized publication of the following statement:

Recent reports in the press indicate that Miethe, in

[1] From *Nature*.

Germany, and Nagoaka, in Japan, believe they have converted mercury into gold by the use of large currents in a mercury arc lamp. If this is true it has probably resulted from the shooting of an electron into the nucleus of a mercury atom, which would convert it into an atom of gold provided the electron should remain in the nucleus. It must be said that the velocities given to electrons in a mercury arc lamp are much smaller than those which may be imparted in other ways, and that present atomic theories seem to indicate that it is exceedingly improbable that such slow electrons could get at the nucleus. However, the success of the work of Miethe and of Nagoaka can be tested only by experiment, and if they are proved successful, the theories must be changed to account for their success. Such experiments will need to be extremely careful and convincing.

Work has been begun in this laboratory on the method by means of which electrons with thousands of times higher velocities are shot into mercury in order to see if they attach themselves to the mercury nuclei and thus produce gold. It is the opinion of those who have begun this work that even these greater concentrations of energy will be insufficient, and that still more powerful and expensive sources of energy may need to be applied. That gold happens to be the element which might be produced by such a process is of no scientific, and probably of no practical importance, since if any other element could be prepared in the same way it would be of the same interest to science, and any gold produced would be enormously more expensive than the commercial value. The choice of these elements for the scientific work is entirely due to the fact that mercury is easily separated from gold, and gold in extremely small amounts may be detected.

THE ROYAL PHOTOGRAPHIC SOCIETY

THE Royal Photographic Society of Great Britain is holding its seventieth annual exhibition in September and October of this year. This is the most representative exhibition of photographic work in the world, and the section sent by American scientific men heretofore has sufficiently demonstrated the place held by this country in applied photography. It is very desirable that American scientific photography should be equally well represented in 1925, and, in order to enable this to be done with as little difficulty as possible, I have arranged to collect and forward American work intended for the scientific section.

This work should consist of prints showing the use of photography for scientific purposes and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Saturday, June 14. They should be mounted but not framed. There are no fees.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I may arrange for the receiving and entry of the exhibit. Address

EASTMAN KODAK COMPANY, A. J. NEWTON
ROCHESTER, N. Y.

THE EASTERN NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY

IN accordance with its new policy of distributing its regular meetings among the towns in its territory, the eastern New York Section of the American Chemical Society held its one hundred and twenty-fifth regular meeting in Troy in cooperation with the Rensselaer Polytechnic Institute, on March 31. Dr. Zay Jeffries, of the Aluminum Company of America, addressed the meeting on "Aluminum."

About 300 engineering students of the institute attended the meeting. Dr. Jeffries showed rare ability in selecting his topics, so that his address appealed to the engineers and to the scientific men alike. A large number of the local members of the Association of Steel Treaters also attended the meeting from Watervliet and Schenectady.

Dr. Palmer C. Ricketts, director of the institute, presided. Before the meeting, the members of the section from Schenectady, Albany and the other towns around Troy were entertained by Dr. and Mrs. Ricketts at their home with a buffet luncheon.

At the conclusion of the meeting, a party was organized for a tour through the engineering laboratories of the institute. The Troy division of the section certainly managed the affair in fine shape, and a hearty vote of thanks was extended them at the close of the address of the evening.

Dr. Charles A. Kraus, head of the department of chemistry of Brown University, addressed the one hundredth and twenty-sixth regular meeting of the section in the Research Laboratory of the General Electric Company, on the morning of April 4, on "The amphoteric nature of the elements."

His lecture was concerned with his own research work on liquid ammonia solutions, a field in which Dr. Kraus is the acknowledged authority to-day. By applying the accepted theory for atomic structure, he showed that all elements should be either electropositive or electronegative, depending only on circumstances. Until Dr. Kraus started his investigations on ammonia solutions, most of the elements were electropositive, and very few could be made to show any other set of properties, for the reason that in any other state these elements, and their resulting compounds, were extremely reactive, especially to moisture.

Such compounds have now been prepared and worked with. Particular emphasis was placed on the uncommon properties so revealed by such a common element as lead. In many cases, Dr. Kraus was able to foretell his experimental results with surprising accuracy, showing his theory to be correct.

Dr. Kraus emphasized his belief that some such

reasoning as he has employed might prove of great value to the metallurgist in explaining the properties of many of the alloys with which he is familiar.

P.

A NOTABLE GIFT TO MATHEMATICS

The publication, February, 1925, of the first of the Carus Mathematical Monographs marks the beginning of an enterprise made possible by a notable gift to the Mathematical Association of America by Mrs. Mary Hegeler Carus as trustee of the foundation underlying the Open Court Publishing Company, of Chicago.

These monographs are an expression of the desire of Mrs. Carus and of her son, Dr. Edward H. Carus, to contribute to the dissemination of mathematical knowledge by making accessible at nominal cost a series of expository presentations of the best thoughts and keenest researches in pure and applied mathematics. These expositions are to be set forth in a manner comprehensible not only to teachers and students specializing in mathematics, but also to scientific workers in other fields, and especially to the wide circle of thoughtful people who, having a moderate acquaintance with elementary mathematics, wish to extend their knowledge without prolonged and critical study of the mathematical journals and treatises. It is proposed to state in the preface of each monograph the extent of mathematical knowledge presupposed on the part of the reader.

In this first of the series of monographs, entitled "Calculus of variations" by Professor G. A. Bliss, of the University of Chicago, the author assumes that the reader has an acquaintance with the elementary principles of the differential and integral calculus, but even without such knowledge the geometrical or mechanical statements of the problems, the introductions to the various chapters and the italicized theorems throughout the book should be intelligible to any reader interested in mathematics. In the final chapter only some simple properties of differential equations are presupposed, but these have already been illustrated in the preceding chapters and are described in detail in the text.

These monographs are published for the Mathematical Association of America and are distributed at cost to its members. They are made accessible to the general public through the Open Court Publishing Company, of Chicago, Illinois.

This generous gift by Mrs. Carus to the Mathematical Association of America is especially timely in view of the great difficulty now experienced by all scientific organizations in meeting the high cost of printing both of journals and of books. She is thus not only making possible the publication of high-grade mathematical books which otherwise would be quite beyond the power of the association to handle, but she is also enabling the association to do a real service for the large body of those who have a definite interest in mathematics but who are not technical specialists in this field.

The second monograph in this series will soon be ready for the printer. It is entitled "Functions of a complex variable," by Professor D. R. Curtiss, of Northwestern University. Still others are in preparation. The opportunity for service in this line by the Association seems quite unlimited. In fact, no limit is contemplated so long as the purpose in view seems to be successfully attained.

H. E. Slaught

THE DANIEL GIRAUD ELLIOT MEDAL

The National Academy of Sciences having approved the recommendation of the Committee on Award of the Daniel Giraud Elliot Medal for 1924, the medal and honorarium will be presented at the April meeting of the academy to Abbé Henri Breuil for his work, in collaboration with MM. Capitan and Peyrony, on the volume, "Les Combarelles des Eyzies," as the most outstanding contribution of 1924 in this field.

Henri Breuil is the foremost living authority on the archeology of the Old Stone Age. His chief contributions are the recognition of the great Aurignacian upper paleolithic stage and the monographing of the entire Stone Age art of France and Spain. "Les Combarelles des Eyzies" is the last and most comprehensive of a series of epoch-making monographs; it describes and interprets every one of the 291 figures discovered in the Grotto of Combarelles. Abbé Breuil is a man of untiring endeavor, great personal courage and deliberate and philosophic interpretative powers. He is the head officer of the Institut de Paléontologie Humaine, which was founded by the late Prince of Monaco.

This is the eighth award of the Daniel Giraud Elliot Medal, previous presentations having been made as follows:

1917: Frank M. Chapman—"Distribution of bird life in Colombia."

1918: William Beebe—"A monograph of the pheasants."

1919: Robert Ridgway—"Birds of North and Middle America" (Part VIII).

1920: Othenio Abel—"Methoden der Palaobiologischen Forschung."

1921: Bashford Dean—"A bibliography of fishes" (Volume I).

1922: William Morton Wheeler—"Ants of the American Museum Congo Expedition."

1923: Ferdinand Canu—"North American Later Tertiary and Quaternary Bryozoa.

HENRY FAIRFIELD OSBORN, *Chairman*,
American Museum of Natural History
CHARLES D. WALCOTT,
Smithsonian Institution,
FREDERIC A. LUCAS,
American Museum of Natural History

SCIENTIFIC NOTES AND NEWS

THE general meeting of the American Philosophical Society will be held in the hall of the society in Philadelphia on April 23, 24 and 25.

DR. WILLIAM H. WELCH, director of the School of Hygiene and Public Health of the Johns Hopkins University, celebrated his seventy-fifth birthday on April 8.

THE Society of the Physical and Biological Sciences of the University of Erlangen has elected Professor Carl Barus, of Brown University, to honorary membership.

To celebrate as a national event the seventy-ninth birthday of Edward Dean Adams, engineer, financier and philanthropist, a dinner was given to him at the Waldorf-Astoria, New York, on April 9. The speakers included Dr. W. F. Durand, professor emeritus in Leland Stanford University and president of the American Society of Mechanical Engineers; James M. Beck, solicitor-general of the United States; A. Monro Grier, president of the Canadian Niagara Power Company, and Mr. Adams.

DR. GEORGE F. DICK and his wife, Dr. Gladys H. Dick, of Chicago, have been nominated by the Gorgas Memorial Institute of Tropical and Preventive Medicine for one of the Nobel prizes, in recognition of their work in the treatment and prevention of scarlet fever.

UPON the recommendation of the medals committee, the board of directors of the Geographical Society of Chicago on March 20, 1925, voted to award the Helen Culver Gold Medal of the society to Professor Eugenjus Romer, of the University of Lvov, Poland.

THE Samuel D. Gross prize of the Philadelphia Academy of Surgery for 1925, amounting to $1,500, has been awarded to Dr. John Alexander, Ann Arbor, for his essay entitled "History, present practice and proposed reform of the surgical management of pulmonary tuberculosis."

ON his arrival at Buenos Aires, Dr. Albert Einstein, who was welcomed by delegations from various scientific bodies, was elected an honorary member of the Academy of Science.

DR. J. S. HALDANE, fellow of New College, Oxford, has been appointed Gifford Lecturer at Glasgow for the years 1926 and 1927.

M. EUGENE FICHAT, director of the Marine Hydrographic Service of France, has been elected a member of the section of geography and navigation of the Paris Academy of Sciences to take the place of the late M. Bertin, recently deceased.

M. GEORGES FRON, professor of pathological and cryptogamic botany at the Institute of Agronomy, Paris, has been made a chevalier of the French legion of honor.

D. N. PRIANISHNIKOV, professor of agriculture, celebrated the thirtieth anniversary of his scientific work at Moscow, during March.

AT the annual meeting of the Geological Society of London, Dr. J. W. Evans was elected president. The vice-presidents elected were: Dr. J. S. Flett, Sir Thomas Holland, Professor A. C. Seward and Sir Arthur Smith Woodward.

DR. PAUL J. ANDERSON, research professor of plant pathology at the Massachusetts Agricultural College, resigned on April 1, to become plant pathologist in charge of the tobacco substation of the Connecticut Experiment Station. His new address is Windsor, Connecticut.

SINCE the death of its founder the direction of the State Serological Institute, Vienna, has passed into the hands of his pupils, Professors R. Kraus and E. Pribram. The control of the products will be in the hands of a control station established by the public health bureau.

DR. ROBERT GRAHAM, chief of the animal pathology and hygiene divisions at the University of Illinois, has a year's leave of absence to organize animal disease control work in Haiti and to study tropical diseases of livestock.

DR. S. BOSHNAKIAN, formerly of the New York State Institute of Applied Agriculture, has been in the interior of eastern Venezuela since last December, engaged in survey work.

DR. OTHENIO ABEL, professor of paleontology in the University of Vienna, delivered two of the annual public lectures on the Spencer Trask Foundation at Princeton University on April 1 and 2, taking as his subjects "Adaptation to arboreal life and flight" and "The Pleistocene fauna of the Dragon Cave near Mixnitz, Austria."

PROFESSOR W. KOLLE, director of the Institute for Experimental Therapy, Frankfort-on-the-Main, delivered a series of four lectures under the Herter Foundation of the Bellevue Hospital and Medical College on "Facts and theories on Chemotherapeutic research" on April 13, 14, 15 and 16. Dr. Kolle will deliver the eighth Harvey Society Lecture at the New York Acad-

emy of Medicine on Saturday evening, April 18. His subject will be "The abortive cure of syphilis in the light of experimental studies."

DR. JOSEPH JASTROW, head of the department of psychology at the University of Wisconsin, lectured during the week of April 13 at Skidmore College, Cornell University, Colgate University and Syracuse University. The engagements were arranged by the Central New York Division of the Psychological Corporation at Hamilton, N. Y.

DR. WHEELER P. DAVEY, of the Research Laboratory of the General Electric Company, gave two lectures at the Massachusetts Institute of Technology on April 6 and 7. The first was on "Atomic and ionic shapes and sizes and the nature of chemical combination." The second was on "The theory of solid solutions and the theory of ductility."

DR. MARTIN H. FISCHER, of the University of Cincinnati, lectured before the Albany Medical College on March 14 on "Edema and nephritis."

DR. WILLIAM SNOW MILLER, emeritus professor of anatomy at the University of Wisconsin, recently gave a lecture before the students and members of the faculty of the college of medicine of the University of Illinois on "Problems connected with the study of pulmonary structure."

DR. C. D. HOWE, dean of forestry at the University of Toronto, delivered on March 28 an address to the Royal Canadian Institute on "Some aspects of our forestry problem."

DR. ARTHUR DENDY, professor of zoology at King's College, London, since 1905, known for his work on sponges and publications in biology, died on March 24 at the age of fifty-nine.

LORD CURZON, the British statesman and diplomat, who died on March 20, was distinguished, apart from politics, as a geographer and student of the peoples of the East.

A CORRESPONDENT writes: Charles Dayton Woods, for many years Director of the Maine Agricultural Experiment Station, died at his home in Newton, Mass., on March 30. He was born in Brooks, Me., September 11, 1856, graduated from Wesleyan University, Middletown, Conn., in 1880 and received the degree of Sc.D. from the University of Maine in 1905. From 1880 to 1883 he taught in the chemistry department at Wesleyan and from 1883 to 1888 in the Wilbraham (Mass.) Academy. He was associated with the Storrs (Conn.) Experiment Station, as chemist from 1888 to 1896 and as vice-director from 1891 to 1896. From 1896 to 1920 he was director of the Maine Agricultural Experiment Station and, in addition, professor of agriculture in the University of Maine (1896 to 1903) and food expert for the government (1894–1908). During 1921 he was consultant in agriculture for the U. S. War Department at Camp Devens, Mass., and since then has been director of information of the Massachusetts Department of Agriculture, until his resignation on account of ill health about a month previous to his death. He has contributed numerous articles to various scientific journals and reports chiefly on subjects related to agriculture and foods. He was a fellow of the American Association for the Advancement of Science and a member of the American Chemical Society. He was also a member of the Chi Psi Fraternity and of the honorary societies of Phi Beta Kappa and Phi Kappa Phi.

THE second annual meeting of the Northwest Scientific Association will be held in the Lewis and Clark High School, Spokane, Washington, on April 10 and 11, immediately following the meetings of the Inland Empire Education Association. Over sixty papers will be presented in the general sessions and in the meetings of sections in chemistry and physics, geology and geography, botany and zoology, plant pathology, bacteriology, medicine and education. At the annual dinner in the Hall of the Doges, Davenport Hotel, on Friday evening, the address of the retiring president of the association, Dean M. F. Angell, will be given on "The unity of science." The officers for the present session are: Chancellor M. A. Brannon, University of Montana, Helena, Montana, *President;* L. K. Armstrong, Mining Engineer, Spokane, *vice-president;* J. E. Wodsedalek, professor of zoology, University of Idaho, *treasurer;* F. D. Heald, professor of plant pathology, State College of Washington, Pullman, Washington, *secretary.*

THE Chemical Foundation has given $1,000 to the New Jersey Sewage Sub-Experiment Station in connection with the studies pursued at that laboratory on the underlying principles of biological sewage disposal. Another $1,000 has been given to the Engineering Experiment Station of the University of Illinois.

DURING the course of the Pasteur centenary celebrations, held in May, 1923, a Pasteur "day" was held throughout France, when badges were sold in aid of the scientific laboratories of the country, and some nine million francs were collected. A committee under the chairmanship of M. Émile Picard, permanent secretary of the Paris Academy of Science, was appointed to distribute the fund, and a list of the allocations is given in the *Revue scientifique* and in *Nature.* Grouping the awards according to subject, they are as follows: 2,143,000 francs to physics, of

which 1,000,000 francs is reserved for the construction of a powerful electromagnet for the Paris Academy of Sciences; 1,340,000 francs to chemistry; 1,150,000 francs for astronomy, of which 650,000 francs will be for a photographic instrument and for a reflector of 1.20 m. aperture; 160,000 francs to mathematics, 120,000 francs of which is for the publication of the works of Henri Poincaré; 190,000 francs to meteorology; 245,000 francs to geography and navigation; 333,000 francs to geology and mineralogy; 630,000 francs to zoology; 640,000 francs to botany; 576,000 francs to physiology and medicine; 105,000 francs to microbiology; 75,000 francs to agriculture; 600,000 francs for the general biology of the Colonies; 510,000 francs for industrial research and institutions. Three million francs were collected by the *Matin* which will be invested and the interest used for prizes and grants.

"THE Lloyd-Cornell Wildflower and Nature Preserve," consisting of four hundred thirty-six acres of wild land near the headwaters of Six-Mile Creek, nine miles out of Ithaca on the Slaterville Road, has recenty been purchased by Curtis G. Lloyd, of Cincinnati, Ohio, and set aside for the use of the public, especially for scientific study. The donor will also finance the improvement of the tract and the preservation of its natural resources. It will be administered by a board of trustees, most of them Cincinnati business men, with a local custodian, presumably a member of the Cornell University faculty.

THE registrar-general has issued his corrected vital statistics for England and Wales for 1924. There were 730,286 births and 473,270 deaths. The natural increase of population by excess of births over deaths was therefore 257,016, the annual average increase in the preceding five years having been 335,352. The number of persons married during the year was 592,048. The marriage rate was 15.3 per thousand of population. The birth rate was 18.8 per thousand and the death rate 12.2. Infant mortality was 75 per thousand registered births. The birth rate was the lowest recorded except during 1917–1919; the death rate was 0.6 per thousand above the rate for 1923; the infant death rate was 6 per thousand births above the 1923 rate.

A NATIONAL museum has been established at Canberra, Australia, planned to become the world's center for the study of the fauna of Australia. A correspondent of the *Journal* of the American Medical Association writes as follows: "This step has been taken none too soon, for the fauna of Australia, in consequence of the introduction of civilization and of European species, is rapidly disappearing. It is hoped that physicians throughout Australia, realizing that the fight is against time, will help the museum in every way. The study of the Australian fauna from the standpoint of comparative anatomy was begun in 1788 by Dr. John White, the first Australian surgeon general and a friend of John Hunter, but little further was done until recent years. It is computed that within a period of twenty years many of the Australian mammals will have become extinct. To further their study from the comparative standpoint, Dr. Colin Mackenzie founded in Melbourne the Australian Institute of Anatomical Research, which includes a museum and laboratory. In 1923, Dr. Mackenzie made a gift to the government of his laboratory equipment and his collection of museum specimens and living animals. This valuable collection will form the nucleus of the National Museum, of which Dr. Mackenzie will act as director."

WE learn from *Nature* that the ship *Discovery*, which is to be employed in research into whaling in South Georgia and the South Shetlands, and, incidentally, in scientific work affecting oceanography, meteorology and magnetism, is still undergoing reconstruction at Portsmouth, and it is not likely that she will be commissioned for several months to come. If time permits, it is proposed that the *Discovery* should proceed to Stanley, Falkland Island, carrying out a program of scientific observations on the way; and that from Stanley she should proceed to South Georgia, arriving there about the commencement of the whaling season in October, 1925. Meanwhile a marine station in connection with the expedition is being established at Grytviken, South Georgia. The building was constructed in sections in England to facilitate erection locally. Provision has also been made for a laboratory, and a considerable portion of the necessary scientific equipment has been shipped. Simultaneously with the erection of the marine station, a wireless station and other buildings belonging to the Colonial Government are being constructed under contract with the Marconi Company. The scientific staff at the marine station will consist of three zoologists and a hydrologist with a laboratory assistant, *viz., Zoologists:* N. A. Mackintosh (in charge), J. F. G. Wheeler, L. H. Matthews; *Hydrologist:* A. J. Clowes; *Laboratory assistant:* A. Saunders. The officers of the expedition who have already been appointed are as follows: Scientific officers—*director of research:* Dr. S. W. Kemp; *zoologists:* A. C. Hardy, J. E. Hamilton, E. R. Gunther; *hydrologist:* H. F. P. Herdman.

ACCORDING to the *Experiment Station Record*, the Ling Naam Agricultural College, which is the College of Agriculture of Canton Christian College, is contemplating the establishment of a fertilizer testing

station. It is expected that its work will include analyses of soils, crops and fertilizers; tests of fertilizers and other combinations of various soils and crops; lectures and laboratory instruction, and special short courses on the use of fertilizers and other extension work. The station is to have its headquarters at the college with the head of the department of agronomy as director. Acquisition of about 60 acres of land under lease at $1,800 per year or by purchase at a cost of $45,000 is expected. The plans also contemplate the erection of a fertilizer building to cost, with equipment, about $40,000, together with two residences to cost $5,000 each and several cottages for workers to cost about $2,800. The main building would contain classrooms, a laboratory and living quarters for at least 20 students. The expense of maintenance is estimated at about $6,500 per annum.

ADDITION of 21,000 acres to the White Mountain National Forest in New Hampshire has been announced by the National Forest Reservation Commission. The purchase increased the government-owned area within the forest to 462,200 acres, representing an investment of $3,370,000. By later acquisitions it is planned to expand the forest to 960,600 acres. Purchase of the 21,000 acres added to the government timber reserve 33,000,000 feet of soft woods and more than 35,000,000 feet of hard wood, and the area is expected to produce annually 7,000 cords of soft wood and 2,000,000 feet of hard wood. The total stand of timber in the forest is estimated to be nearly one billion board feet of merchantable stock, of which more than half is soft woods suitable for making print paper.

UNIVERSITY AND EDUCATIONAL NOTES

WILLIAM C. PROCTOR has made a gift of $200,000 to Princeton University to provide additional facilities for the graduate college.

CHARLES T. ALDRICH and Henry L. Aldrich, brothers, have announced joint gifts of $500,000 each to Brown University and to the Rhode Island Hospital on condition that an equal amount shall be raised by each institution.

BY the bequests of the late Dr. John Hall, a graduate of Glasgow, and his sister, the university receives about £50,000 for tutorial fellowships in medicine, surgery and obstetrics, and for the better equipment of the practical classes in these subjects.

THE Northwest Paper Company and the Cloquet Lumber Company, of Cloquet, Minnesota, have given the sum of $4,000 to the division of agricultural biochemistry of the University of Minnesota to be used during 1925 for fundamental studies on the chemistry of wood products and wood utilization. The fund is known as the "Cloquet Wood Products Fellowship Fund." Mr. Kurt W. Franke (M.S., Virginia) and Mr. David R. Briggs (M.S., Missouri) have been appointed research fellows under this fund.

ARNOLD H. JOHNSON (Ph.D., Minnesota, 1924), assistant professor of agricultural biochemistry in the University of Minnesota, has been appointed assistant chemist in the Montana Agricultural Experiment Station, to succeed Paul F. Sharp (Ph.D., Minnesota, 1922), who has been appointed professor of dairy chemistry at Cornell University.

DR. CLIFFORD H. FARR, assistant professor of botany in the State University of Iowa, has been appointed associate professor of botany in Washington University at St. Louis.

HUBERT G. SCHENCK has been appointed instructor in paleontology at Stanford University.

DR. JOSEPH BURTT DAVY, at one time instructor in botany in the University of California, has been appointed lecturer in tropical forest botany in the Imperial Forestry Institute, Oxford University.

SIR HUMPHRY DAVY ROLLESTON, president of the Royal College of Physicians, has been appointed Regius professor of physic at Cambridge in succession to the late Sir Thomas Clifford Allbutt.

DR. WALTER GOSSNER, professor of mineralogy at the University of Tübingen, has been invited to occupy the chair of mineralogy and crystallography at the University of Munich.

DR. OTTO FISCHER, professor of chemistry at the University of Erlangen, who is retiring shortly, will be succeeded by Professor Rudolph Pummerer, of Griefswald.

DISCUSSION AND CORRESPONDENCE

THE EXTENSION OF THE YUCCA MOTH

MANY years ago Dr. George Engelmann, of St. Louis,[1] recorded that he was struck with the fact that "Yuccas do not bear fruit" in Europe. He and Dr. C. V. Riley[2] noted that the Yucca was pollinated by the Yucca moth. The method of pollination was described in detail. Subsequently Dr. William Trelease published a fine monograph of the genus Yucca, giving some notes on the pollination of the genus, the species of which are generally pollinated

[1] Transactions Academy of Science, St. Louis 3: 18. *Bull.* Torrey Botanical Club 3: No. 7.

[2] C. V. Riley. Transactions Academy Sciences, St. Louis 3: 55.

by the Yucca moth.[3] The Yucca moth was evidently common in St. Louis, where several species had long been cultivated. Engelmann's observations were made somewhat earlier than 1873.

Yucca has been cultivated in Ames as early as 1888. I had frequent occasion to note the flowering of this plant, but until three years ago I had not seen any of the capsules. Only a few were observed then. I did not, however, note whether the pollination was brought about by the Yucca moth. A few weeks ago one of my freshman students brought to me a fine panicle of fruit with more than a dozen capsules, every one of which showed circular holes left by the emerging of the larvae. Evidently the Yucca moth has only been recently introduced at Ames. The plants observed are in the station grounds of the Northwestern Railway. There are plants on the college campus two miles away, but none of these, so far as I know, have produced seed.

The *Yucca glauca* Nutt is common on the loess bluffs along the Missouri River in western Iowa. It is evident that the insect has been introduced from this source. The species cultivated in gardens at Ames is a form of *Yucca filamentosa.*

L. H. PAMMEL

AMES, IOWA

NOISE AND HEARING

THE discussion of the relation of noise to hearing that has appeared in SCIENCE October 17, December 12 and March 6 prompts me to report my own personal experience.

In the spring of 1921 I had an attack of Bell's Palsy, from which I did not recover for more than a year. During the period when the nerves of the entire left side of my face were giving me constant pain, there were such noises as the barking of a dog when close to me and the "Klaxon" on an automobile that were painful. Musical tones did not produce the same painful effect nor the usual tones of the voice in conversation, but the contact of iron tires on a wagon with the street-car rails had a painful effect. I tried to plug my left ear, especially when driving a car, but this did not lessen the annoyance from a "Klaxon" when a car drove by me on passing. This peculiar sensitiveness to these noises continued for more than two months and did not disappear until after the nerves of my face ceased to be painful. My hearing is above the average in keenness for low sounds but distinctly faulty for musical pitch and tone quality. I can not distinguish any difference in the general quality of my hearing since I recovered, and the pain from the types of noises mentioned is absent.

Immediately on giving symptoms of Bell's Palsy, I was examined by a regular physician and a specialist on ears and was constantly under their care. After recovering, I was again examined and at no time was there any evidence of alteration of my general sense of hearing. Their attention was directed to the reaction just given which was one of the reasons for special attention being given to testing both ears at that time. I was not given an explanation at that time nor have I since accounted for this selective defect in my hearing during the apparent progress of degeneration of the nerves in my face.

W. M. SMALLWOOD

SYRACUSE UNIVERSITY

THE DEATH OF ARCHIMEDES

AN ancient mosaic representing the death of Archimedes has just been described by Franz Winter, the archeologist of Bonn, in an illustrated publication issued in Berlin by Walter de Gruyter and Company. This mosaic has been in private ownership in Wiesbaden, since 1860, when it was obtained from the estate of Jérome Bonaparte. The mosaic came originally from the city of Herculaneum, that was destroyed by an eruption of Vesuvius in 79 A.D. It represents a Roman soldier approaching with drawn sword, and Archimedes seated at a table and turning toward him, with hands raised as if to protect the figures drawn in the sand on the table. According to this mosaic the geometric figures were not drawn in sand on the floor, as commonly reported, but in sand on a suitably designed table. Winter is convinced of the genuineness of the mosaic and discusses a number of questions of archeologic interest.

FLORIAN CAJORI

UNIVERSITY OF CALIFORNIA

ANTI-CONSERVATION PROPAGANDA

ALTHOUGH I have already sent a letter of protest to the American Forestry Association in regard to the misleading information regarding forest conservation contained in an article in a recent number of its magazine contributed by Mr. A. H. Carhart who "for four years served the United States Forest Service as recreation engineer," the persistent and industrious circulation of such propaganda that has been going on for some time is having such a serious effect that I would like to call the attention of SCIENCE readers to it, especially to the following extract:

> It would be quite acceptable if we could stop the laws of nature from moving forward in some particularly fine bits of woodland and hold them just as they are, for the use of the public for many generations. But there is no fountain of youth for the tree. We can

[3] Report Missouri Botanical Garden 13: 27 (See 124).

not set aside for all time something which is not stable, something which is changing as the seasons change. It would be as sensible as to suggest making a park preserve out of a particularly brilliant stand of oaks because of their fall coloring as to propose such a reservation of a growing forest. Both are passing conditions. One is more transitory than the other, but the principle is the same.[1]

Of course individual trees grow old and die. So do human beings, but should they all be poisoned or asphyxiated as soon as they are mature? Is it not one of the basic facts of forest science and one that we might expect every one in the Forest Service, even if only one of the wood chopping engineers, to be perfectly familiar with, that a forest under natural conditions maintains itself, as the population of a human community does, the trees being of all ages, the younger individuals that have been growing up taking the place of the aged ones that die off from time to time? A forest may and often does maintain itself unimpaired century after century. If this were not so, why was a large part of this country covered with magnificent forest with trees several to many centuries old when the first settlers came? Can we doubt that it would still be so but for human interference?

And as for the individual trees, is it not true that most of our native timber trees are long-lived, able to live and grow in a flourishing condition for 200 to 300 years, some of them very much longer? No more pernicious nonsense can be disseminated than the idea that if we do not hurry up and cut the rest of our dwindling supply of timber the forests are going to fall down and rot like a crop of weeds. Were cutting down what our forests need, it would seem as though they had been getting it in plenty for nearly three centuries.

We shall never get any real conservation in this country until people wake up to a realization of how the tentacles of commercial interests have penetrated, not only the branches of our government, but also most of the conservation organizations.

WILLARD G. VAN NAME

NEW YORK

THE NEW SECRETARY OF AGRICULTURE AS A SUPPORTER OF SCIENTIFIC RESEARCH

GREAT satisfaction and pleasure have been manifested over the appointment of President W. M. Jardine to the position of Secretary of Agriculture. During the two weeks intervening between the time of the announcement of his appointment and the induction into office (fortunately for his welfare it was no longer) he has been hailed and extolled as the "cow puncher" who has come on up, farmer, educator, economist, level-headed citizen, Rotarian, golfer and all with approximately correct estimation and the warmest sincerity.

However, several of the most excellent, perhaps some of the most significant characteristics of the new Secretary of Agriculture have not appeared to receive the public notice that they deserved. One of these is his attitude towards serious scientific endeavor. During the thirteen years that he has been director of the Kansas Agricultural Experiment Station and then president of the college, science, even just for science's sake, has hardly had anywhere a more keenly open-minded and generous supporter. Whether the project called for the investigation of the fauna of the alimentary tracts of termites or the physics involved in a musical tone, if there was prospect of the exercise of energy and integrity in the prosecution of it, his support was enlisted. On the other hand, if the investigation gave promise of valuable economic results, either immediately, or remotely, it was not thereby "tainted" as science. An investigator might superintend the economically important rodent project calling for end results as rapidly as they could be secured, and, at the same time, diligently seek the causes of the absorption, during sexual activity, of the pubic symphyses of female pocket gophers.

The secretary, although most responsive to wholesome public sentiment, has not been deluded by that harmful myth to the effect that farmers, boards, governors and others are constantly bringing desperate pressure to bear on state institutions to secure exclusively results that are capable of immediate practical application, thus enforcing superficiality. Only this year he was able to say that difficulties of this nature had not been imposed upon him.

ROBERT K. NABOURS

SCIENTIFIC BOOKS

Principles of General Physiology. BY SIR WILLIAM MADDOCK BAYLISS, 4th Edition, 1924, Longmans, Green & Company, London.

THIS edition of a book unique among all its kind appears just a decade after the first, and only a few months after the author's death. The tautologous title is still retained and is still somewhat misleading. For treatises on the principles of any science heretofore have led us to look for a style almost stereotyped. One recalls Newton's "Principia," v.

[1] *American Forests and Forest Life*, February, 1925, p. 71.

Haller's "Elementa Physiologiae," the "Treatise on Natural Philosophy" by T and T′, or even a book as modern as Tigerstedt's late edition of his "Physiologie des Kreislaufs," in all of which the style is objective to the nth degree and above all utterly free from any concern for the frailties of poor human nature. Upon opening this book, however, one finds at first glance a work that is almost journalistic.

The volume, an octavo, contains some 750 pages that, to the regret of all presbyopes and hyperopes, are made up of paragraphs of fine print alternating with paragraphs of still finer print; but interspersed throughout are so many full-page portraits, photogravures of things and places, reproduced kymograph records, diagrams and graphs that an additional ten pages are required in which merely to list them. Throughout the text the names and titles of so many authors and their works are referred to that another 106 pages (names in heavy-face type) are required for a special bibliography. A general index of twenty-five pages and a topical tabulation of contents covering eight pages, together with the special indices just mentioned, make the book one of ready reference for all it holds.

As one peruses the text, not the chapter titles, here about how best to varnish smoked paper, there about how best to smooth a curve of plotted results together, with a sympathetic expression of regret that physiologists must also know mathematics, followed by a friendly introduction into the subject, a definition of Cartesian coordinates, full-page portraits of two mathematicians and the birthplace of one of them; and, again, here a quotation from Virgil on crop rotation and there a biassed attack on Rowntree's "Poverty, a Study in Town Life," one feels however far removed all this may be from general physiology it nevertheless may be condoned as a method to maintain the interest of the jaded reader, who willy-nilly once he opens the covers, cardinal red in this case, must read on and on.

Of the total twenty-four chapters eight are on topics in physical chemistry and of those on nutrition, secretion, digestion, nervous system, respiration and circulation (seven in all) much, if not most, of the matter belongs to the field of special physiology. On the chapters proper to the field of general physiology those on "Catalysis and Enzymes," "Excitation and Inhibition" and "Tonus" are probably the best, although whatever any of them has failed to include or whatever bias of view anywhere is taken, the mass of material collected, marshaled into place and brought under review by the author is at all times a cause for wonder.

Throughout the text there is a certain unevenness of style. Whole pages here and there may be made up of faultless exposition all highly illuminating which finally trail off into a mere concatenation of authors' abstracts. Reading the chapters thus has the effect of kite-flying, the string of abstracts being tails that sometimes help and sometimes hinder the flight of the kite. The constant citation of names and dates indicates an earnest desire to give the prior author credit in mention of sources. But now and then one wonders how our author failed to do so. In many of these cases there is the understandable, if not always pardonable prejudice, in favor (a) of British investigators and (b) especially of all those whose work was done at the author's institution, University College, London. Seeming conflict even of these prejudices at times is in evidence, as on page 43.

Here the argument is developed to show how in some physiological processes it may be futile to apply the method of temperature coefficients as a touchstone for the presence of hidden chemical reaction. The argument is well taken, but the examples given to show how the method has failed are poorly chosen. One of these is an observation on the influence of temperature upon the rate of the isolated mammalian heart contained in work done at University College.

Now it happens that H. Newell Martin, a Britisher in an American laboratory, was the first not only to develop a method for maintaining the beat in an isolated mammalian heart, but, together with Applegarth, was also the first to observe that the rate of beat is a linear function of the temperature. Our author wishes to make the point that since the velocity of chemical reactions is a logarithmic function of temperature, and the rate of the heart beat a linear function, the temperature coefficient is no index of underlying chemical reaction leading to the inner stimulus to beat. That evidence exists, showing that the rate of the mammalian heart is a logarithmic function of temperature, the author does not state. Now since nowhere else in the book is this matter again taken up it appears that the author wished to keep the reader in ignorance of this newer and conflicting evidence.[1]

As another example of the futility of the method in question the case of the nervous impulse is taken up, and in support articles by British authors again are quoted to the exclusion of prior American work, a priority that the investigators quoted also ignored. Indeed so attached was Sir William Bayliss to the work of his countrymen that he does not see the fallacies in the experimentation and in the logic of

[1] See an article by the reviewer in *Zeitschr. f. allgem. Physiologie*, 1913, 15: 72, especially p. 82.

one of the articles quoted at this point. In this latter article the nervous impulse is compared to the propagation of the burning of gunpowder in a fuse, and experiments are reported in which the velocity of this propagation of burning gunpowder was observed at so-called different temperatures. No considerable difference in the velocity of the propagation of the combustion was observed. The conclusion was drawn that, since in this case chemical action was known to be taking place and yet changing the external temperature did not affect the velocity of propagation, it would be quite fallacious to use the converse case of a system whose internal action was unknown and to argue that because the effect of changing its external temperature was what one expected of a chemical action, therefore, the internal action of the unknown process must be chemical.

The answer to this argument is that it all depends upon whether the changes of temperature outside the system in the two cases actually changed the temperature of the reacting bodies inside the system. In the case of the nerve trunk no physiologist would doubt that experiments, properly planned and carried out, would effect a change of internal temperature, or that a change from 10° C. to 20° C. of the external surface of the nerve trunk would represent also a change of temperature of the same magnitude of the functional structures to within say one per cent. To physicists and chemists this would be all the more certain if they knew that the inner reaction progressed with little or no heat exchanges of its own.

Now the nervous action in its propagation is known to be accompanied by no measurable amount of heat changes.[2] On the contrary, the combustion of black gunpowder, for example, so-called British service powder, is observed to have a heat of combustion of 714 thermal units per gram, and the rise of temperature caused by its explosion is given as 2,200° C.[3] Indeed the temperature of burning powder may be calculated from the known specific heats and the observed heat of combustion of the powder. The calculated value of the latter, namely, 660 thermal units, is somewhat less than the observed value quoted above. The specific heats given for the reacting substances in no one case is greater than 0.3. The lowest figure therefore would be $\frac{660}{0.3}$ or 2,200° C. Now when packed in a heat impervious jacket with particles in close contact with one another, as is the case in such fuses, one sees at once that changing the temperature external to the jacket from 1° C. to 100° C., as was done in the experiment quoted, would have practically no effect upon the reacting system within. For the chemical reaction when once started would raise the internal temperature of the system at that point from 1,000 to 2,000 times above that of contiguous points and of the external environment. How much a burning front of 2,200° C. would be accelerated or retarded in its march by powder lying in its path at 100° or 0° C. may be seen at once by most of us, and perhaps may be calculated to a nicety by one familiar with the laws of cooling bodies.

It is inferred beforehand that the effect would be very slight indeed, as the author quoted found it to be. But it is equally certain that this author did not obtain the proper data upon which to base a calculation even for an approximate temperature coefficient of the propagation of powder combustion. Such data could only have been obtained had he varied the temperature of the powder say some 100 per cent. on either side of that of the combustion temperature, that is, from 0° to 4,000° C. For it is thus that the data for calculating a temperature coefficient of the velocity of the impulse of the frog's nerve is obtained. The nerve functions normally at room temperature, say 18° C., but in the experiment the nerve is cooled nearly to freezing and warmed as high as 33° or 36° C. This establishes a variation of about 100 per cent. to either side of the middle point. We are reasonably certain that the observed temperature is the temperature of the substance where the nerve action takes place, and the changed velocities observed are beyond all doubt the direct result of the changed temperatures. What is more, this changed velocity can be shown to be a logarithmic function of the temperature. On the other hand, it is clear that the gunpowder-fuse experiment failed to yield the data it was intended to yield and that the conclusion based upon the erroneous data that the experiment did yield is completely fallacious.

This page of the book in review is only one, but happens to deal with a subject of which the reviewer has expert knowledge. The query naturally arises, if all the pages were reviewed by experts on the subjects under discussion, would all be found to contain so many errors of judgment? Most probably not all, but if only one tenth of them were found so full of error one still would like to ask whether it is for this reason the book is called, as it is said to be in London, "a text-book for professors." The reviewer is rather inclined to say of the book what a distinguished colleague said when its first edition appeared, "It is a book of love."

Sir William Bayliss put into this book all the things that happened both to please and interest him,

[2] *Vide inter al.*, Professor Max Cremer, 1896.

[3] See Lewes and Brame, "Service Chemistry," London, 1913, pp. 250 and 315.

and his interests were deep and burning. He loved great works of science and made idols of the men who created them. The many full-page portraits in this volume so caressingly displayed, the exquisite care given in that spacious but ill-balanced bibliography, the excessive citation of the works of the very great and of many lesser lights who happened to win his favor, all attest this intense interest in the persons of science. He loved his countrymen, but the men of his college more; he read much and labored long; now and then he reflected on the manifold speculations concerning human life.

All this he has put into this remarkable book. Its title changed to "The Adventures of a Scientist," however inadequate, would have been a more descriptive title. For no treatise on the principles of a science ever turned out to be such a palpably human document.

Paraphrasing the words of the chief editor, the book must indeed now stand as a monument to the memory of Sir William Maddock Bayliss, and as a witness to the affection of his friends. But let the stranger outside the gate use as caption to every page the motto that adorns the title page,

"πάντα δοκιμά ζετε
το καλόν κατέχετε"

which translated as Sir William expounds in his original preface reads: Prove all things, hold fast to that which is good, and beautiful, and therefore, even as Plato taught, of a necessity also true.

CHARLES D. SNYDER

THE JOHNS HOPKINS UNIVERSITY

CANCER IN PLANTS AND IN MAN

RECENTLY in *Klinisches Wochenschrift* (3 Jahr., Nr. 25) and in *Zeits. für Krebsforschung* (21 Bd., 5 Heft.) Dr. Ferdinand Blumenthal, director for some years of the Universitäts Krebsforschung Laboratories, connected with the great Charity Hospital, Luisenstrasse, Berlin, with two assistants, Dr. Hans Auler and Fraulein Paula Meyer, claim to have isolated several times from human breast carcinoma schizomycetes in pure culture with which they have been able to produce malignant transplantable tumors in white rats (carcinomas and sarcomas). One form of this organism, that used most successfully, they state to be indistinguishable from *Bacterium tumefaciens* isolated from plant tumors and studied for many years in the U. S. Department of Agriculture by Erwin F. Smith and his colleagues. With this form, known as *PM*, they have also produced repeatedly, in the hothouse and out of doors, tumors on plants indistinguishable from crown galls.

The rat tumors are now in the eleventh and twelfth generation of transplants. The rat tumor is often a mixed tumor, but sometimes it seems to be a diffuse carcinoma and at other times it looks like a pure sarcoma. I have slides showing this wide difference made from two gland metastases taken from the same rat, one day apart. The tumor metastasizes freely into the glands, the mediastinum, the lungs, etc., but, unlike common rat sarcoma, has not been found in the kidneys. So far the best results have been obtained with *PM* and *L*, both cultures isolated from breast carcinomas. Various other isolations have been made from malignant human tumors (carcinomas, sarcomas and epitheliomas) to the number of sixteen, but for want of assistants and experimental animals all have not been tested on animals. The two strains mentioned (*PM* and *L*) are the most like the crown-gall organism, especially *PM* (the first one isolated, two years ago) which has given remarkable results in both plants and animals, many of which I have seen. It should be noted, however, that isolations are not easy, and that only a small proportion of the inoculated rats have given persistent, transplantable, metastasizing tumors. In the greater number of rats (something not surprising) the tumors receded. It is also to be noted that the bacteria have not been recovered from the transplants.

At the great Actien-Gesellschaft Serumwerk, in Dresden, which I have also visited, the Berlin experiments have been repeated with the same results, *i.e.* (1) They have obtained in white rats numerous good, freely metastasizing tumors (I saw a dozen or more dissected rats and also live ones) by successive transplants beginning with a transplant tumor-bearing rat received a year ago from Dr. Blumenthal. This proves nothing, of course, as to the etiology of the tumor. But (2) they have also obtained two transplantable freely metastasizing tumors, now in the fifth and sixth generation, starting from pure-culture inoculations of *PM* to which was added Kieselgur (sterile diatomaceous earth), but no oedematous cancer serum or cancer juice, such as Dr. Blumenthal used, but which used alone or with Kieselgur, he says, did not cause any transplantable tumors. In the Dresden experiments, as in Berlin, only a small proportion of the bacterially inoculated rats gave persistent metastasizing tumors (two out of fifty), but it is the same type of tumor.

It begins to look, contrary to my belief hitherto, as if *Bacterium tumefaciens* might occur frequently on or in man and be the cause of some of his cancers.

I came here with great scepticism, but I have seen enough, here and in Dresden, to lead me to think that the Berlin experiments should be repeated, as now undoubtedly they will be, in many other cancer lab-

oratories, and snap judgments should not be taken if the first isolations fail.

The results of Dr. Blumenthal and his associates are the more interesting because they started out on their crown-gall studies a half dozen years ago, entirely sceptical as to its cancerous nature. Along with all other Germans, they regarded it as a granuloma and only as they studied its behavior more and more were they gradually forced to change their views. The following is one paragraph from the summary in their second paper which is best given in their own words:

Aus diesen Untersuchungen ergiebt sich, dass es zum *erstenmal* gelungen ist aus menschlichen Krebsgeschwülsten Parasiten zu gewinnen und in Reinkultur zu züchten, mit denen wir experimentell an Tieren bösartige Geschwülste erzeugen konnten. Diese Geschwülste lassen sich in vielen Generationen fortzüchten. Sie zeigten in ihrem histologischen Bau namentlich bei Übertragungen Carcinom-häufiger Sarkomcharakter, wuchsen bis zur halben Grösse des Tieres heran und bildeten Metastasen, die fast Walnussgrösse erreichten. Sie gaben bei der 4. Übertragung 75% Ausbeute. Auch an Pflanzen lässt sich mit diesen Kulturen, ohne Zusatz irgend eines Reizmittels wie Kieselgur u. dgl., eine Tumorbildung hervorrufen, die in ihrer Ausdehnung in nichts der durch *Bacterien tumefaciens* erzeugten nachgab. Wir glauben, dass die neoplastischen Bacillenstämme, die wir fortgezüchtet haben, dem *B. tumefaciens* nahestehen und mit diesem eine Gruppe bilden, die man als neoplastische Gruppe bezeichnen kann (p. 407).

ERWIN F. SMITH,
President of the American Association for Cancer Research

BERLIN, MARCH 5, 1925

SPECIAL ARTICLES

NOTES ON THE DEVELOPMENT OF THE SEA-CUCUMBER, THYONE BRIAREUS[1]

WHILE staying at the Marine Biological Laboratory, Woods Hole, Mass., in the summer of 1921, I was fortunate enough to have an opportunity, from June 21 to 24, to obtain eggs of *Thyone briareus*, which were reared successfully for nearly three months during my sojourn there.

The present preliminary account is mostly confirmatory of what is known in other Echinoderms, such as starfishes and sea-urchins, but since our knowledge of the embryology of holothurians is still meager, I think it desirable to put it on record.

In the ovarian tube of *Thyone briareus* are found eggs which may roughly be classified into three stages. To the first (1) belong late oogonia or early oocytes with a comparatively large nucleus, in which the chromosomes arrange themselves in pairs and often show more or less distinct polar orientation. The second stage (2) is characterized by diversities in the size of the cell body, which fact shows that the oocytes are now rapidly growing. In the nucleus there are a number of nucleoli and the chromatin nets stain very faintly. In early ones, however, paired chromosomes are still recognizable. Among rather late ones the nuclear contents show homogeneous chromatic granulations, and the chromosomes, now gemini, are well formed and assume the shapes of O, X, Y, etc., scattered near the periphery of the nucleus. A single nucleolus is usually found. Probably this stage is passed very rapidly, and after that the nucleus again assumes the appearance of an ordinary germinal vesicle.

In the growing oocytes, but never in those of other stages, is found a peculiar structure in the cytosome. It consists of a few chromatic fibers in the form of a minute spindle or aster, sometimes surrounded by faint rays, and always situated near the end which later becomes the animal pole. It is found only in the specimens fixed with picro-sulphuric, but has invariably disappeared in those fixed with Bouin. A similar but somewhat different structure can also be seen in my slides of other sea-cucumbers, *Cucumaria saxicola* and *C. echinata*. Van der Stricht described a peculiar structure in the growing oocytes of the sea-urchins, *Echinus microtuberculatus* and *Sphaerechinus granularis*, and called it the astrophere. I believe it is identical with the structure in my preparations and should be taken as a modified centrosome (yolk-nucleus of some authors). The fact that it appears coincidently with the growth period suggests that the structure has something to do with the yolk formation.

The third stage (3), to which belong the full-grown oocytes ready to be laid, can be readily distinguished from the others by the presence between the egg surface and the follicular epithelium of a thick jelly coating. It is quite possible that between this and the preceding stage (2) a whole year intervenes, that is, the eggs of the second stage are to be laid next summer. The oocyte, now in its full size, is hemispherical or flattened sphere in shape, as is well known in the eggs of other sea-cucumbers. The germinal vesicle is large and lies eccentrically near the animal pole. This pole is usually directed toward the internal lumen of the ovarian tube, and is readily recognizable by the presence of a short conical process, which I once called the "micropyle appendage." The centrosomal structure, which was found in the preceding stage, is no more to be found. Instead of it, from the micropyle appendage a bundle of achromatic fibers

[1] Contributions from the Zoological Laboratory, Kyushu Imperial University, No. 1.

diverge toward the germinal vesicle. The wall of the vesicle nearest these fibers shows some wrinkles, among which is usually seen a chromatin mass of irregular contour. In some slides of *Cucumaria echinata* a number of chromosome threads radiate from this chromatin mass. This resembles very much the structure found in the spermatocytes of some insects and myriapods (Blackman, 1903; Meves, 1905; Payne, 1909; Browne, 1913; etc.) and which is known as the karyosphere. From comparison of these with the observations of Jordan and of Retzius on starfish eggs, I am inclined to think that in my case also the mass in question is the source of the chromosomes.

Often among the oocytes above described, one finds some irregular masses of large and small disintegrating yolk, inclosed in the germinal follicle like the oocytes. These are probably the eggs which had failed to be laid in the previous spawning season, and which have undergone degeneration. A remnant of the germinal vesicle may be found, unusually with enlarged nucleoli. Within the yolk masses a number of small nuclei can be found, and I think that they represent phagocytes. Similar features have already been noticed by Gerould in *Caudina arenata,* by Théel in *Mesothuria intestinalis,* and by Caullery and Siedlecki in *Echinocardium cordatum.*

Spawning always occurs late in the afternoon of the day in which the animals are brought into the laboratory. By putting the animals in dim light, however, I could induce them to spawn even in day time. When returned to light they suddenly ceased to spawn, but in dim light laying was again observed. Utter darkness, on the other hand, did not cause them to spawn. In no case could I observe isolated females spawning spontaneously, but it is always preceded by sperm emission of a male or by males lying near.

Observations of Newth on *Cucumaria normani* and of Ohshima on *C. echinata* agree in that the eggs when laid have already formed the second polar spindle. This seems to be incorrect so far as my new observations on the present species justify. The eggs pipetted immediately out of the genital papilla show invariably the *first* polar spindle in rather early metaphase. In no case have I found the nuclear membrane remaining. The germinal vesicle is represented by the so-called residual substance, near the center of which are seen one or several nucleoli diminished in size.

Judging from the fact that the germinal vesicle remains intact in early stages of the degenerating oocytes, as mentioned above, it seems probable that the breaking down of the germinal vesicle takes place after the egg becomes detached from the ovarian wall, but before it leaves the genital papilla, *i.e.,* while the egg travels through the oviduct.

The egg freshly laid measures 260 to 300 μ in the largest diameter across the equatorial plane, and 200 to 210 μ in thickness, *i.e.,* along the egg axis. The jelly membrane, now free from follicular epithelium, measures 60 to 80 μ in thickness and shows radial striations as is well known in other cases. The first polar body is pinched off within about 20 to 30 minutes after the egg is laid. As it is absolutely impossible to keep the eggs quite free from sperm, it is hard to say whether the polar division is stimulated by the presence of sperm or not, although it seems highly probable that the first polar spindle is arrested at the metaphase stage until the entrance of a sperm. In the eggs which have already formed the first polar body a sperm head could always be demonstrated in stained sections. The second polar body is constricted off from the egg about 30 minutes after the first. While forming the polar bodies, the egg changes its shape obviously from alternate changes in viscosity of the plasm. It becomes more rounded during divisions and again flattens after the throwing out of the polar bodies.

The chromosomes on both the first and second polar spindles do not divide synchronously, and they do not form any regular equatorial plate at the metaphase. It is therefore quite difficult to tell their exact number; the probable haploid number being 22.

The centrosome is usually invisible in the first polar spindle, but in the second it is easily seen on each end of the spindle. After the second polar division the chromosomes belonging to the egg are more or less regularly arranged in a plane and swell up to form each a chromosomal vesicle. In those lying peripherally the change takes place more rapidly than in the central ones. At the same time the group of growing vesicles move down, preceded by an aster, toward the center of the egg, and they rapidly fuse to form a single egg nucleus.

The entrance of the sperm takes place most frequently near the equator of the egg, but rarely at the vegetal pole, while no sperm whatever has been found to enter at or near the animal pole. At first it is of the shape of a chestnut, with the aster radiating from its apex, but it soon becomes an ovoid vesicle. Whether its centrosome divides during the migration I am unable to say, because, as a rule, the centrosomal structures are rather indistinct in this material. The two germ nuclei meet at the center of the egg, and as they are at that time of about the same size and structure, one can distinguish them only from their positions. The egg nucleus usually lies on the side of the animal pole, while the sperm nucleus is found either lateral or nearer the vegetal pole.

There seems to be a stage when the nuclear membrane between the apposed germ nuclei disappears, thus forming a single first cleavage nucleus. The first cleavage spindle soon appears, although the origin

of its centrosomes could not be followed with certainty. Chromosomal vesicles are formed at the anaphase of the division. The cleavage furrow appears first at the animal pole and proceeds faster at this side than at the vegetal. The 2-cell stage is reached within about two hours after spawning, then after half an hour comes the 4-cell stage, and the 8-cell stage after still another half hour.

For the account of the further development no detailed study has as yet been made, and it must be postponed to future communications; a rough sketch of observations may, however, not be superfluous here.

As I have before noticed in *C. echinata,* the blastomeres arrange themselves in a spiral manner in the present species also. The spirality is not so regular as is seen in those typical cases, such as in Turbellaria, Polychaetes and Gasteropods.

A gastrula is formed by the 18th to the 20th hour. It has cilia all over the surface of body, but is still inclosed within the egg membrane, often with the polar bodies attached at one side. The so-called *dipleurula* stage also is passed within the egg membrane, and it is not until the *metadoliolaria* is fully formed, when three and a half days old, that the young holothurian becomes free from the egg membrane and creeps out. Thus a free-swimming stage is here entirely lacking. The only other known example of this sort is *Holothuria floridana* as studied by Edwards. The *metadoliolaria* just escaped from the egg membrane has a big hanging preoral hood, five unbranched tentacles and a pair of ventral pedicels.

The preoral hood is gradually absorbed and the animal can now be called the *pentactula.* It creeps about and feeds on detritus found on the bottom of the vessel. The tentacles begin to branch, and new ones appear until the normal number of ten is reached. Ventral pedicels also increase in number, and calcareous deposits, in the form of plates, tables and rods, appear on the walls of body, of tentacles and of pedicels.

In conclusion, the fact is noteworthy that, despite the small size of the egg, no planktonic larval stage appears in this species. On the other hand, some sea-cucumbers with large yolky eggs, such as *Cucumaria frondosa* (up to 650 μ, Nordgaard), *Psolus phantapus* (600 μ, Runnströms) and *Cucumaria echinata* (440 μ, Ohshima), produce typical free-swimming larvae.

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HETEROPLASTIC GRAFTS OF THE ANTERIOR LIMB-LEVEL OF THE CORD IN AMBLYSTOMA EMBRYOS

THE following is a brief report on the results of some preliminary experiments carried out in the spring of 1924 for the purpose of testing the effect of a foreign source of innervation on the development of the anterior limb-bud of *Amblystoma* embryos. That the anterior limb-rudiment of *Amblystoma* is self-differentiating and, therefore, independent of nervous influence, at least in early stages, is indicated by the work of Harrison and his students. Harrison has replaced the limb-buds from *A. tigrinum* with those of *A. punctatum,* and vice versa, and found that the transplanted limb-rudiment developed very much as it does in its normal location. In the present experiments, the limb-level of the cord in these two species was exchanged, the limb-rudiments remaining in their normal positions. In carrying out the operations, two embryos, one of each species, were arranged side by side and a segment of the cord corresponding to somites 3, 4 and 5 was excised from each and reimplanted in normal orientation in opposite embryos. Sixty-six pairs were operated upon in this manner, the results of which are summarized in the following table:

Series	Operations	Embryos	Stages	Dead at end of seven days	Survivals
I	5	punct.	24	5	0
	5	tigr.	25	5	0
II	16	punct.	21	13	3
	16	tigr.	24	16	0
III	18	punct.	24	15	3
	18	tigr.	26	15	3
IV	12	punct.	23	10	2
	12	tigr.	25	12	0
V	15	punct.	23	15 (1 fixed)	0
	15	tigr.	25	15	0
Total	132			111	11

It will be noted that out of a total of 132 embryos operated only 11 (not counting one fixed) survived the first week, which is always the period of heaviest loss in experiments of this kind. However, the high mortality in this case was due in all probability not so much to the character of the operation as to the fact that the *tigrinum* eggs had to be shipped from Chicago to New Haven, where the experiments were carried out in the Osborn Zoological Laboratory of Yale University. The *punctatum* eggs were collected in the vicinity of New Haven.

The table also shows that the highest percentage of survivals was obtained in Series III, in which Stage 24, for *punctatum,* and Stage 25, for *tigrinum,* were used for operating. This group also proved to be the hardiest and it was possible to carry one of them to metamorphosis.

The eleven embryos surviving the first week were of varying degrees of vitality and all except one were preserved at different times during an eight-week period following operation. One of them, belonging to Series III, a *tigrinum* embryo with a *punctatum* graft, lived to the onset of metamorphosis, as already noted. It reached a length of ten centimeters and seemed to be in vigorous health, but, unfortunately, died during transportation from Woods Hole to New York. However, it was possible to preserve it at once so that it was not a total loss.

Comparison with control animals showed that limb development in operated embryos proceeded in a normal fashion both structurally and functionally, at a somewhat slower rate. So far as the observations go they substantiate the general conclusion reached by Harrison that the anterior limb-rudiment of *Amblystoma* is a self-differentiating system.


Fig. 1

Sectioned embryos show that the transplanted cord unites with the cord of the host and becomes an integral part of the latter's nervous system. Presumably, the nerves forming the brachial plexus and innervating the anterior limb grow out from the transplanted cord segment; but this matter requires more extended study before a definite conclusion can be reached.

A fuller account of this work will be published elsewhere and, in the meantime, more extended experiments will be carried out this spring which, it is hoped, will furnish more abundant material for study.

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CHROMOSOME NUMBERS IN MAMMALS[1]

As my investigations upon the sex chromosomes of mammals have been extended I have had occasion to make diploid chromosome counts in three orders of eutheria which I have not reported on before. In two instances the chromosome numbers reported by earlier investigators have been found erroneous.

Rodents: The rabbit was studied and counts were made on amniotic tissue in both prophase and division phases. The chromosome number for the rabbit was reported to be about 22 by Bachhuber ('16). I find consistently 44 chromosomes in the cells of 8 different embryos. Figure 1 gives the typical appearance of an amnion cell. When the chromosomes of different embryos are paired up, in some individuals all elements have mates of like size and shape, while other embryos have two elements without mates of like size or shape. From this we may conclude that the sex chromosomes of the rabbit are of the X-Y type. A detailed study of the spermatogenesis is now being made.

Edentates: The amnion of armadillo embryos has been studied. The chromosome number for this form had been previously reported as approximately 31 in the male, by Newman and Patterson ('10). I find consistently 60 elements (Fig. 2) in all amnion cells. My investigations on this form have not been carried on far enough as yet to indicate the type of sex chromosome which may be found here.

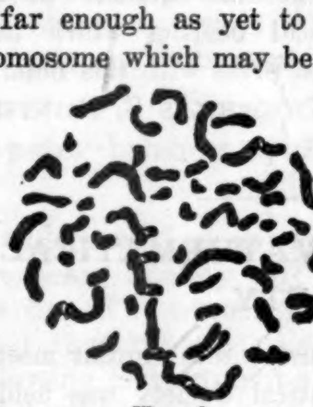
Fig. 2

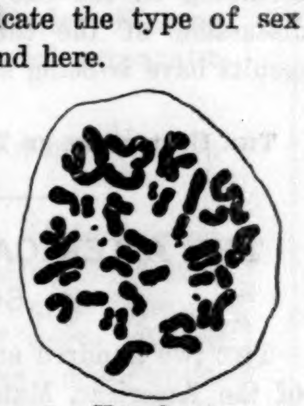
Fig. 3

Insectivors: The spermatogonia of the common European hedgehog has been studied. As Fig. 3 will show there are 48 chromosomes in this animal. This is the first chromosome count to be made on any insectivor, as far as I am aware.

We now know the diploid number of species in seven out of nine eutherian orders, the cetacea and sirenia being the only orders not yet investigated.[2] The chromosome numbers encountered in the species so far studied are as follows:

[1] The writer has been aided in this work by a grant from the Committee for Research on Sex Problems.

[2] For more extensive data concerning the counts given below see bibliography under Painter, 1924, in *Amer. Nat.*, Vol. LVIII, p. 524; Bachhuber, L. J., 1916, *Biol. Bull.*, Vol. 30; Newman and Patterson, 1910, *Jour. Morph.*, Vol. 21.

Insectivor—Hedgehog		48
Chiroptera—Bat		48
Primates—	Man	48
	Macacus	48
	Cebus	54
Ungulata—Horse		60
Edentata—Armadillo		60
Carnivora—Dog		50 +
Rodent—Rabbit		44

It is thus clear that the typical eutherian number is a high one, and the occurrence of 48 chromosomes in three different orders would seem to indicate that it may be about the typical number.

The facts recorded above are of especial interest in that they indicate a unity of chromosome constitution above the marsupial level and effectively dispose of the suggestion that extensive polyploidy may have occurred within this subclass.

In the marsupials the chromosome number is a low one and in the opossum is 22. At first sight it might appear that the eutherian condition might have arisen from this by tetraploidy. There are two objections to this, however. In the first place the bulk of the chromatin in marsupials is about the same as in the eutheria, using the sex chromosome as our measure. In the second place, polyploidy could scarcely occur successfully in animals with X-Y sex chromosomes, as most mammals possess, because of the complications occurring in the sex chromosome balance. A full discussion of the theoretical bearing which these results have is being sent to press with this note.

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THE AMERICAN MATHEMATICAL SOCIETY

THE two hundred and thirty-ninth regular meeting of the American Mathematical Society was held at Columbia University on Saturday, February 28, 1925, extending through the usual morning and afternoon sessions. The attendance included sixty-one members of the society. There was no meeting of the council or of the trustees.

At the beginning of the afternoon session a paper was read, at the request of the program committee, by Professor J. W. Alexander, of Princeton University, on "Problems in the topological theory of manifolds."

The following other papers were read:

Minimal varieties of two or three dimensions whose element of arc is a perfect square: C. L. E. MOORE.

Fields of parallel vectors in a Riemannian geometry: L. P. EISENHART.

On the Riemann tensor: G. Y. RAINICH.

Integrals in curved space: G. Y. RAINICH.

Comitants of a curve under inversion: FRANK MORLEY.

Null geometry: EDWARD KASNER.

Extensions of the equations of Gauss and Codazzi: LOUIS INGOLD.

Tensors determined by a hypersurface in a Riemann space: HARRY LEVY.

Symmetric tensors of the second order whose covariant derivatives vanish: HARRY LEVY.

Congruences with constant absolute invariants: H. L. OLSON.

On normal forms of differential equations: W. F. OSGOOD.

Two new arctangent relations for π: A. A. BENNETT.

Diophantine arccotangent relations: A. A. BENNETT.

The fitting of curves by the use of moments and conjugate moments: E. L. DODD.

Linear complex of conics: E. E. LIBMAN.

On the map-coloring problem, with particular reference to connected sets of pentagons: C. N. REYNOLDS.

Solution of the problem of the thick rectangular plate, clamped or supported at its edges and under uniform or central load: C. A. GARABEDIAN.

A complete solution of the cubic equation: GLENN JAMES.

Functions of two variables for which the double integral does not exist: R. L. JEFFERY.

On the number of elements in a group which have a power in a given conjugate set: LOUIS WEISNER.

The number of even and odd absolute permutations of n letters: J. M. THOMAS.

Note on the projective geometry of paths: J. M. THOMAS.

Combinatorial analysis situs: J. W. ALEXANDER.

On the regions of convergence of real power series in several variables: O. D. KELLOGG.

Transcendental transcendency of certain functions of Poincaré: J. F. RITT.

Concerning the sum of a countable infinity of mutually exclusive continua: J. R. KLINE.

On extending a continuous (1, 1) *correspondence of two plane continuous curves to a correspondence of their planes:* H. M. GEHMAN.

The inverse problem of the calculus of variations. Preliminary report: J. H. TAYLOR.

On the problem of inversion of abelian integrals: S. LEFSCHETZ.

Osculating curves and surfaces: PHILIP FRANKLIN.

On the momental constants of a summable function: R. E. LANGER.

The solution of a difference equation by trigonometric integrals: NORBERT WIENER.

On Gibbs' phenomenon: T. H. GRONWALL.

Some remarks on Dirichlet's series: EINAR HILLE.

Remarks on convex regions: BÉLA DE KERÉKJÁRTÓ.

The society will meet at Columbia University, May 2, 1925.

W. BENJAMIN FITE
Acting Secretary